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SOVIET EXPLOITATION OF THE "NUCLEAR WINTER" HYPOTHESIS

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Union's military might, while it is also explained that the dire predictions of the possible consequences of a nuclear war in no way diminish the utility of the Soviet civil defense program and the need for its further improvement.

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PREFACE

The purpose of this report is twofold. First, it attempts to examine Soviet public statements on the hypothetical "Nuclear Winter" effect from a nuclear war, which has been widely discussed in the United States. Second, it seeks to ascertain whether Soviet scientific spokesmen, as has been widely asserted, have in fact made independent contributions to the study of the "Nuclear Winter" phenomenon and have confirmed its probable occurrence for a range of possible war scenarios. The report is based entirely on Western and Soviet open source materials dealing with the "Nuclear Winter" hypothesis and on the author's personal conversations with some of the key Soviet scientific spokesmen involved in "Nuclear Winter" studies at the International Seminar on Nuclear War, which was held in Erice, Italy, in August of 1983.

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SUMMARY

In the past two years the Western scientific community and public have paid considerable attention to the hypothesis that a nuclear war may cause a catastrophic global "Nuclear Winter" which could jeopardize mankind's survival. The main initiators and sources of this hypothesis have been two studies by Western scientists. The first, by Paul J. Crutzen and John W. Birks (Ambio, Sweden, 1982), drew attention to the possible climatic effects of massive injections into the atmosphere of smoke and soot from large fires ignited by nuclear detonations. The second was the so-called TTAPS study (Science, December 1983), widely popularized by Dr. Carl Sagan, which attempted to assess the possible climatic consequences of a number of selected war scenarios. During 1983, Soviet scientific spokesmen publicly embraced the "Nuclear Winter" hypothesis and published several models for the climatic consequences of a nuclear war which they presented in various international forums in the West.

Soviet science spokesmen and media have claimed, and this was initially widely accepted in the West, that Soviet scientists had independently confirmed the probability of a "Nuclear Winter" phenomenon as a consequence of a nuclear war. An examination of open Soviet publications specifically discussing this prediction, however, show this claim to be unfounded. In their writings on the "Nuclear Winter" hypothesis, Soviet scientists have neither used independent scenarios nor provided independent values of the essential parameters characterizing soot, on which the "Nuclear Winter" hypothesis principally depends. Instead, Soviet spokesmen have uncritically used in toto the "worst-case" scenarios and estimates of the Crutzen-Birks and TTAPS studies and merely adapted them to mathematical simulations of multi-dimensional models of global atmospheric circulation after the nuclear war. Even the model itself in the case of the widely publicized study by V. Aleksandrov and G. Stenchikov is based on a borrowed obsolete Western model.

Naturally, given the sources of Soviet inputs to their studies, their findings do not represent independent verifications of the "Nuclear Winter" hypothesis. In fact, Soviet scientists have contributed very little, if at all, to the international "Nuclear Winter" study effort. Their models are characterized by American scientists as "crude" and "flawed," and so far they have not responded to the latter's request for data derived from Soviet pre-1963 nuclear tests and large fires, and for scenarios that the Soviets believe to be likely.

An examination of Soviet public discussions of the "Nuclear Winter" hypothesis indicates that the Soviets have seen it primarily not as a scientific but rather as a political and propaganda opportunity and have sought to exploit it accordingly. The Soviet objective has been to reinforce the "anti-nuclear" movements in the West, to influence the opinion of the Western public and especially of its scientific community, to enhance opposition to U.S. defense and foreign policies, and also to lend support to Soviet arms control proposals. For this purpose, the Soviets saw no utility in becoming involved in scientific debates in the West over the validity of the "Nuclear Winter" hypothesis or to provide independent scenarios or data which might have been at variance with its assumptions and projections. From the Soviet viewpoint, it was sufficient to adopt this hypothesis and to merely give the impression of its "independent" confirmation by Soviet scientists.

This is not to say that over the years there have been no Soviet studies published examining various effects and phenomena of nuclear detonations, such as dust, fires, soot, etc. The findings of these studies and their possible relevance to Soviet assessments of the "Nuclear Winter" hypothesis remain to be examined and analyzed. However, the Soviets have made little use of such findings in their public discussions and models of "Nuclear Winter." There is also no public indication of a coordinated effort among Soviet scientists or activities to study the "Nuclear Winter"

question, although one cannot exclude the possibility that there may be a secret program for this purpose. Finally, there are no signs that Soviet official public support for the "Nuclear Winter" hypothesis has had any influence on Soviet strategic weapons programs, the direction of Soviet scientific support for them, or the continuing improvement of civil defense.

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SECTION 1

INTRODUCTION

For the past two years there has been considerable public discussion and debate about the possibility that a nuclear exchange may cause catastrophic changes in the world's climate--that is, a so-called "Nuclear Winter." Although there had been some earlier speculations about possible adverse climatic consequences of a large-scale detonation of nuclear weapons, concern was focused primarily on the possible depletion of the ozone layer and the injection of dust into the stratosphere. In 1982, however, an article by Paul J. Crutzen of the Max Planck Institute for Chemistry (Mainz, FRG) and John W. Birks of the University of Colorado, published in the Royal Swedish Academy of Sciences publication Ambio, drew attention to the possible effects on the amount of sunlight reaching the earth's surface--and, consequently, the surface temperature--of mass fires caused by nuclear detonations and the resulting injection into the troposphere and even stratosphere of smoke, ashes and soot. The article gave impetus to new research on the little-studied possible atmospheric effects of a nuclear war.

At present, the most widely publicized work in the United States on the possible global atmospheric and climatic consequences of a nuclear war has been carried out by a team of scientists: R.P. Turco, O.B. Toon, T.P. Ackerman, J.B. Pollack and C. Sagan, often identified as TTAPS, who introduced the so-called "Nuclear Winter" hypothesis. They formally presented their findings and projections at a "Conference on the World After Nuclear War," which was held in Washington, D.C. on October 31-November 1, 1983, although elements of their work became known earlier. The TTAPS group published their hypothesis in Science, December 23, 1983, and Carl Sagan also published an article on this subject in the Winter 1983-1984 issue of Foreign Affairs. Another article by the TTAPS group was published in Science in August 1984.

Seemingly in parallel with the TTAPS effort, Soviet scientists also examined this problem and published two models of the "Climatic Consequences of the Nuclear War." One such model was developed by G.S. Golitsyn and A.S. Ginzburg of the Institute of Atmospheric Physics of the USSR Academy of Sciences. It was initially discussed at a conference of Soviet scientists in May 1983 and presented at the October 31-November 1, 1983, conference held by TTAPS in Washington. The other, a three-dimensional atmospheric model, was developed by V.V. Aleksandrov and G.L. Stenchikov of the Laboratory for Climate Modelling of the Computing Center of the USSR Academy of Sciences. Aleksandrov first presented his findings at various international scientific conferences during the summer of 1983 and subsequently published them in Russian and English, the English version appearing in October 1983. A number of other Soviet scientists also discussed elements of the "Nuclear Winter" phenomenon at various international conferences during 1983 and 1984. Even so, the most prominent public spokesman for the Soviet "Nuclear Winter" hypothesis has been Academician Ye.P. Velikhov, a vice president of the USSR Academy of Sciences and chairman of the "Committee of Soviet Scientists for Peace and Against the Threat of Nuclear War."

There is a widespread impression that Soviet research on the "Nuclear Winter" hypothesis has been conducted independently of that carried out by Western--especially American--scientists and, consequently, that because of the similarity of their results, the Soviet research independently confirms the findings of TTAPS and the prediction of a "Nuclear Winter." This perception has been reinforced by statements by American as well as Soviet scientists. For example, Carl Sagan made this point at the October 31-November 1, 1983, conference in Washington,¹ and again in his article in Foreign Affairs, in which he noted that he wished "to thank my Soviet colleagues, V.V. Aleksandrov, E.J. Chazov, G.S. Golitsyn and Ye.P. Velikhov among others, for organizing independent confirmation of the probable existence of a post-nuclear war climatic catastrophe."² The

Soviets have also made a point of this, noting, for example, that "Soviet and American scientists frequently, independently of one another, and possibly despite ideological differences, came to similar, almost identical conclusions."³ In the same vein, in his paper presented at the "Joint American-Soviet Scientific Forum on Nuclear War," which was sponsored by U.S. Senators E. Kennedy and M. Hatfield, held in Washington on December 8, 1983, Dr. S. Kapitsa of the Moscow Physio-Technical Institute, pointed to the "correspondence of the work done by different groups working on these problems" (i.e., the climatic consequences of nuclear detonations) as evidence of the scientific credibility of the findings. He went on to state that,

A detailed professional discussion of this work at the recent Conference on the World After Nuclear War here in Washington has unequivocally shown a general agreement on all the main points.⁴

Unlike the United States, no dissenting views or critiques of the TTAPS or Aleksandrov assumptions, scenarios, or models have been published in the Soviet Union.

The general similarities of the TTAPS and published Soviet findings concerning the "Nuclear Winter" hypothesis are undeniable. The question arises, however, whether the Soviet findings are derived from actual independent research which could be seen as offering confirmation of the TTAPS hypothesis or whether they are essentially only a "playback" of Western data, assumptions, and estimates intended primarily to serve political rather than serious scientific purposes. This paper attempts to examine and shed light on this question. At the same time, it should be emphasized that this paper does not intend to examine and assess the validity of the "Nuclear Winter" hypothesis as such.

FOOTNOTES (Section 1)

1. See Anne Ehrlich, Nuclear Winter, a Forecast of the Climatic and Biological Effects of Nuclear War, (Bulletin of the Atomic Scientists, 1984), April 1984, p. 11S.
2. Carl Sagan, "Nuclear War and Climatic Catastrophe: Some Policy Implications," Foreign Affairs, Winter 1983-1984, p. 259. See also statement by Dr. S. Schneider of the National Center for Atmospheric Research in Ehrlich, op. cit., p. 6S.
3. Yu. Petrovskiy, "You are Exposing the Grim Truth," Televideniye i Radioveshchaniye (Television and Radio Broadcasting), No. 1, January 1984, pp. 24-25.
4. Statement by Dr. Sergey Kapitsa at the "Joint American-Soviet Scientific Forum on Nuclear War," sponsored by Senators E. Kennedy and M. Hatfield, December 8, 1983. See also V. Kyucharyants, "'Nuclear Winter'; What Soviet and American Scientists Know and Think About It," Moscow News, No. 13, April 5, 1984.

SECTION 2

SOME EARLIER SOVIET VIEWS ON THE CONSEQUENCES OF A NUCLEAR WAR

2.1 SOME CONSTRAINTS ON SOVIET PUBLIC ASSESSMENTS OF THE CONSEQUENCES OF A NUCLEAR WAR

Actual Soviet beliefs about the possible climatic consequences of a nuclear war have been and remain difficult to determine. This is so for several reasons. First, Soviet public statements on possible climatic consequences of a nuclear war have generally been intended to serve political purposes, i.e., they have been and continue to be made in support of specific Soviet strategic deterrence, foreign and arms control policies and positions, and as a part of Soviet attempts to influence Western public attitudes. Second, Soviet statements have been inconsistent and contradictory, for example, predicting that a nuclear war may result in the destruction of civilization, if not of mankind, while at the same time indicating that the Soviet objective in such a war would be the attainment of "victory" and the survival of the Soviet Union. Third, unlike in the United States, there is no detailed public discussion in the Soviet Union of a range of possible alternate nuclear war scenarios and their implications for climatic conditions. The official Soviet line has been and remains that any nuclear war, which by Soviet definition could only be provoked by US or NATO aggression, could be neither "limited" nor "controlled" in any way, and that the Soviet Union would attempt to resort to a "preemptive" strike. Although general Soviet strategic targeting concepts and priorities can be identified in Soviet open publications, there is little discussion of how Soviet nuclear weapons may be allocated; for example, whether or not the Soviets would target cities or how many industrial, administrative, transportation and other installations located in urban areas of the United States may be attacked. It is not surprising, therefore, that Dr. Sagan's request to Soviet scientists to provide "a range of nuclear war scenarios that they consider likely"¹ went unanswered. Fourth, there is no specific

public discussion of the possible consequences of a nuclear war for the Soviet Union itself. For example, there are no public estimates of the number of possible Soviet casualties that may result from various US attack scenarios, no published maps showing possible fallout areas in the Soviet Union which may result from them, no identification of the localities included in the various Soviet categories of potential risk areas, no analysis of likely areas and sizes of forest fires which may occur in the Soviet Union as a result of nuclear strikes, and so on.²

Undoubtedly the Soviets do study various war and targeting scenarios and make projections of their consequences for the Soviet Union, but these are kept secret and, consequently, cannot be used by Soviet scientists for public assessments of the possible consequences of a nuclear war. It is not surprising, therefore, that Soviet discussions of these consequences are largely based on Western scenarios, projections, and data and that global effects are analyzed primarily on the basis of Western models of aggregate megatonnage of nuclear detonations or numbers of warheads which may be used. It is also not surprising that, given the political objectives of Soviet public discussions of the consequences of a nuclear war, these discussions tend to focus on Western "worst-case" scenarios and warnings.

2.2 SOME EARLY SOVIET PUBLIC VIEWS

Dire warnings of the possible consequences of a nuclear war have periodically been made at the highest level of the Soviet leadership and to a lesser extent by some military spokesmen. The earliest one was by Politburo member and chairman of the USSR Council of Ministers, Georgi Malenkov, who warned in March 1954 that a nuclear war meant "the destruction of world civilization."³ This statement had followed a similar warning by President Dwight D. Eisenhower, which he made on December 8, 1953.⁴ Although Malenkov found some support among some Politburo members for his

mutual-assured destruction thesis,⁵ his faction was overruled by other members led by N. Khrushchev.⁶ The upshot was that by late April 1954, Malenkov had been compelled to retreat and to assert that a Western attack on the Soviet Union "would inevitably lead to the ruin of the capitalist system" and its defeat.⁷ With the fall of Malenkov in 1955, a direct public attack was mounted on his thesis in the party journal Kommunist:

However grievous the consequences of atomic war might be, it must not be identified with the "destruction of world civilization." Such an identification willynilly brings grist to the American imperialist mill; it can create the incorrect concept among the partisans of peace that, as they say, the atomic threat is such that the instigators of war will not dare to use their own bombs, since they will not decide to commit suicide. Such a concept blunts the vigilance of the people toward those who, in the preparation of atomic war, would like to take the peoples by surprise.⁸

This line was repeatedly used against those who believed in the stability of mutual deterrence. While it was acknowledged that nuclear armed missiles posed a particular threat of a surprise attack which could bring about the collapse of its victim's resistance, the public Soviet position was that the Soviet Armed Forces had to be prepared for initiating a "crushing" preemptive strike and the pursuit of a nuclear war to its "victorious conclusion." For example, in 1967 Brezhnev proclaimed, "Let it be known to all that in a clash with any aggressor the Soviet Union will win a victory worthy of our great people, of the homeland of the October Revolution."⁹ The USSR Minister of Defense, Marshal of the Soviet Union A.A. Grechko, wrote in 1971,

At the present time, the Armed Forces should be able under any conditions to thwart a surprise attack by the aggressor

*using both nuclear as well as conventional weapons, and by rapid, crushing strikes defeat his basic nuclear missile weapons and troop groupings, thereby providing favorable conditions for the further conduct and victorious completion of the war.*¹⁰

It should be noted that while acknowledging the destructiveness of a nuclear war, articles in the classified journal of the Soviet General Staff, Voyennaya Mysl', argued that the objective of Soviet strategic strikes was not to reduce the enemy country to a "heap of ruins," but to destroy its immediate capability to wage war.¹¹

The advent of the East-West detente in the early 1970s appeared to have revived the public debate over the consequences of a nuclear war and its implications for Soviet foreign and defense policies. In part, the debate reflected awareness of the Western "mutual assured destruction" view of nuclear war and strategic stability. For example, a book by a collection of military authors published in 1972 noted that, "in the opinion of bourgeois ideologues, a nuclear war, if such a war were to arise...may have only one result--the physical annihilation of mankind," but then went on to assert that,

*The existence of sophisticated weapons making possible the annihilation of hundreds of millions of people by no means signifies the irrevocable doom of mankind if a nuclear war erupts. The concept of nuclear fatalism is fundamentally faulty...*¹²

While some Soviet authors warned that "available nuclear stockpiles are quite sufficient to transform centers of world civilization into deserts," or cause a "holocaust for human civilization" and even threaten "life on earth,"¹³ others, such as Marshal Grechko, persisted in promising a Soviet victory.¹⁴

The orthodox Soviet line was most clearly stated in a Red Star article by Rear Admiral V. Shelyag on February 7, 1974. He criticized those who believed that a nuclear "overkill" had been reached and who denied the possibility of victory in a nuclear war. According to Shelyag,

In the West, for instance, it is claimed that humanity, world civilization, would perish in the event of such a war, that everything living on earth would be annihilated... Marxist-Leninists resolutely reject these attempts. They have always considered and still consider war, all the more so a thermonuclear war, as the greatest calamity for the people. But Communists harbor no sentiments of hopelessness or pessimism.¹⁵

A nuclear war, Shelyag claimed, would end in the collapse of capitalism and in a Soviet victory.

Following the signing of the SALT I Agreement, Brezhnev de-emphasized his earlier predictions of Soviet victory in a nuclear war. Instead, on various occasions he appeared to support the nuclear "overkill" argument and suggested that a nuclear war may have catastrophic consequences without, however, mentioning its specific effects on the Soviet Union. For example, in a speech in Poland on July 21, 1974, he argued that the number of stockpiled weapons "make it possible to destroy every living thing on earth several times."¹⁶ Two years later, he declared that "it has already come to the fact that if the presently accumulated supply of weapons were launched, then mankind would be completely destroyed."¹⁷ At other times Brezhnev suggested that in the event of a nuclear war, the future of mankind "would hang in the balance" or that the survival of civilization and even "life on earth" might be "put into question."¹⁸ Of course, Brezhnev's rhetoric, which lends support to the Soviet "peace policy" and arms control proposals, did not slow the Soviet Union's rapid buildup of its strategic forces throughout the 1970s

and early 1980s. It also had no effect on the continuing retention by Soviet military doctrine of the objective of achieving "victory in a nuclear war." For example, the Chief of the General Staff of the Soviet Armed Forces and First Deputy Minister of Defense, Marshal of the Soviet Union, N.V. Ogarkov, wrote in 1979,

Soviet military strategy proceeds from the view that should the Soviet Union be thrust into a nuclear war, then the Soviet people and their Armed Forces need to be prepared for the most severe and protracted trial. The Soviet Union and the fraternal socialist states will be in this case, in comparison to the imperialist states, in possession of definite advantages: the established just goals of the war and the advanced nature of their social and state systems. This creates for them the objective possibility of achieving victory. However, for the realization of this possibility, there is the necessity for timely and comprehensive preparation of the country and the Armed Forces.¹⁹

Prior to the 1980s, Soviet discussions of the consequences of a nuclear war had generally been couched in very vague terms, although occasionally mention was made of U.S. public or private estimates of possible casualties in the event of a nuclear attack. The Soviets, however, were clearly interested both in American studies of the consequences of a nuclear war and the growing contact between U.S. and Soviet scientists. For example, the 1975 study by the National Academy of Sciences, "Long-Term Worldwide Effects of Multiple Nuclear Weapon Detonations," was translated in the Soviet Union and published in the Russian language in 1977. By the early 1980s, the growth of the anti-nuclear movement in the West led to increasing Soviet efforts to establish contacts with various groups in the movement and to develop cooperation with them. For example, on March 21, 1980, a group of 654 American scientists and physicians addressed an appeal to Brezhnev and President Carter under the

title, "Danger--Nuclear War," calling for the banning of all nuclear weapons. In his reply on March 22, 1980, Brezhnev expressed his support for the views expressed in the appeal and noted that,

U.S. scientists can substantially contribute to an explanation of the disastrous consequences for mankind of a nuclear conflict between the USA and the USSR, a conflict which would inevitably assume a global scale. Such an explanation will help strengthen the will and step-up the activity of those who come out for stopping the arms race, for maintaining normal relations between all countries, including, of course, the USA and the USSR.

You may rest assured that your humane and noble activities aimed at preventing nuclear war will meet with understanding and support in the Soviet Union.²⁰

This was followed on June 6, 1980, by a message to the American authors of the March appeal, signed by a group of prominent Soviet physicians, denouncing U.S. policies, praising Soviet peace policies, and calling for a meeting with their American counterparts.²¹ One reason for the lead being taken by Soviet physicians was the growing activism of the American "Physicians for Social Responsibility" movement. This led to the creation of an officially sanctioned Soviet Committee of "Physicians for the Prevention of Nuclear War." A meeting of leaders of the two organizations in Geneva, Switzerland, in late 1980 resulted in the organization of "International Physicians for the Prevention of Nuclear War," which held its first meeting, attended by representatives from eleven countries, in the United States in March 1981. According to the Soviet account of that meeting,

The participants presented not only data on medical consequences directly linked with the nuclear blast. They not only discussed global changes that might result from the radioactive contamination of the

*stratosphere and the depletion of the ozone layer of the atmosphere, changes in the climate, etc. They also showed that in a nuclear war medicine would not be able to give assistance to hundreds of thousands, millions of wounded, burned and stricken with radiation sickness.*²²

One consequence of the active Soviet participation in the organization of "International Physicians for the Prevention of a Nuclear War" was the discussion by the Soviet participants of nuclear war scenarios and their possible consequences. The significant aspect of this, however, was that the scenarios were either directly taken or adapted from various Western mutual assured destruction scenarios, as was also most of the data on the possible consequences of such hypothetical nuclear wars. For example, on June 26, 1982, Moscow television carried a roundtable discussion by leading members of the Soviet and American organization of physicians. During the broadcast, the vice-chairman of the Soviet Committee of "Physicians for the Prevention of Nuclear War," L.A. Ilyin, an academician of the USSR Academy of Medical Sciences and Director of the Institute of Biophysics of the USSR Ministry of Public Health and Chairman of the USSR National Commission for Radiation Protection, said:

As you know, there is no shortage abroad of the most diverse scenarios of possible nuclear wars, including the use of massive nuclear strikes. I would like to draw the attention of our television viewers...to the fact that we must take some version of a nuclear attack as a point of departure. So, as a basic, we took the U.S. scenario, which was published in 1975 in the special account of a group of American scientists [i.e., the National Academy of Sciences] called "The Long-Term Worldwide Effects of Multiple Weapon Detonations."

It was assumed in the framework of this scenario that in the event of a nuclear conflict between the two opposing sides... an exchange of nuclear strikes would occur

*on the order of a total of 10,000 megatons. Besides, these strikes would be delivered in a zone restricted within latitudes of 30 and 60 degrees north.*²³

From this, Ilyin shifted to a scenario of a nuclear war in Europe which assumed the detonation of 500 nuclear warheads "over 500 of the largest cities in Europe," and 500 other 1 megaton warheads "exploded at ground level, evenly all over the territory of the European continent." Ilyin estimated the total number of casualties from such an attack at 314 million, and noted that "all these figures can easily be extrapolated to the United States."²⁴ This scenario was later published in a number of Soviet English language publications.²⁵

Another example of Soviet use of Western data was the publication in 1982 of a book by Ye.I. Chazov, L.A. Ilyin, and A.K. Guskova entitled The Danger of Nuclear War; Soviet Physicians Viewpoint, in English. Chazov is an academician of the USSR Academy of Medical Sciences, Director-General of the USSR Cardiological Research Center of the Academy, and Chairman of the Committee of "Physicians for the Prevention of Nuclear War." Guskova is a professor of medicine and head of a department at the Institute of Biophysics of the USSR Ministry of Public Health. The text cites 61 references--of these, 42 are Western sources. Most of the 19 Soviet sources deal mainly with various aspects of radiation sickness, and there are also several ethnographic handbooks cited. The authors again cite the 1975 U.S. Academy of Science's scenario in which nuclear weapons with "yields ranging from 1 to 20 megatons" to a total amount of 10,000 megatons are detonated, half in the air and half on the surface.²⁶ From this, the authors attempt to predict genetic consequences and health hazards posed by local and global fallout. The authors also referred to the warning in the 1975 Academy of Sciences study to the effect that not all the possible consequences of a large-scale use of nuclear weapons are known and that "as of today, the number of predictable effects is supposed to be approximately equal to the number of those already known."²⁷

As far as published Soviet materials up to 1983 are concerned, there is no evidence of major Soviet concern about potential climatic consequences of a large nuclear exchange. No doubt, the Soviets noted the mention of possible effects of dust raised by nuclear detonations cited in the 1975 Academy of Sciences study, and they appeared to be interested in the possible damage to the ozone layer. However, in their public discussion, Soviet physicians and scientific spokesmen appeared to follow Western leads and rely on Western studies rather than on independent research work of their own.

2.3 SOME SOVIET VIEWS ON THE FIRE EFFECTS OF NUCLEAR DETONATIONS

Like those in the West, prior-to-1982 Soviet public projections of fire effects of nuclear detonations appear to have ignored the possible consequences for the climate. Fires resulting from nuclear detonations were viewed as a local problem, although the possibility of "mass fires" in urban areas and forests was fully recognized. The effects of smoke resulting from nuclear fires was either ignored or viewed as a problem limited to the localities subjected to nuclear strikes. Most of the Soviet data on nuclear fires mentioned in manuals was derived from the experiences of fire storms in German cities in World War II and the nuclear strikes on Hiroshima and Nagasaki. The Soviet literature did not appear to indicate any significant independent Soviet research on this subject.

According to a Soviet manual on the fire effects of nuclear detonations published in 1973, an "air burst" of a 1 MT nuclear warhead could subject an area of 848 km^2 to in excess of $6\text{-}10 \text{ cal/cm}^2$.²⁸ While large urban fires from nuclear strikes were considered inevitable, the manual asserted that fire storms would occur only under certain special conditions and, therefore, were exceptional rather than regular consequences of nuclear detonations. The following general conditions for the occurrence of fire storms were cited:²⁹

- The presence of a high density of relatively flammable structures of the old inner-city type or the spilling of flammable liquids in an area in excess of 100 hectares and, according to other manuals, not less than 250 hectares [100 hectares = 1 square kilometer].

- The absence of wind or only weak surface wind not exceeding 5 m/s, and a relative humidity of less than 30 percent.

- Presence of combustible materials equivalent to not less than 200 kg/m² of wood per 1 km² of area.

Under these conditions, it was said that fire storms could occur in areas where the density (i.e., area on the ground) of highly flammable single-story structures (i.e., wooden structures) exceeds 30 percent or the density of such two-story structures exceeds 20 percent. In the case of more fire-resistant structures, i.e., those with brick walls and flammable roofs, fire storms may occur if the density of two-story buildings is 30 percent or more, or 20 percent in the case of three- to five-story buildings. The possibility of fire storms in areas of modern fireproof structures was excluded. Indeed, the manual asserted that "the occurrence of fire storms here [USSR] is possible only in areas of older-type construction in the cities, while in the new areas, built up with buildings of Category I and II fire resistance [i.e., concrete, stone and brick buildings with non-flammable roofs], the possibility of occurrence of fire storms is virtually excluded."

The manual also claimed that in the areas of total destruction of buildings by blast, fires in the rubble of fire-resistant buildings would be of low to medium intensity with a great deal of smoldering and intense smoke.³⁰ However, fire storms may occur in the rubble of highly flammable buildings if their density is 30 percent or greater and if they are subjected to thermal radiation of 50 or more cal/cm².³¹

These assessments remained essentially unchanged in Soviet manuals dealing with the effects of nuclear strikes published between 1973 and 1982. Fire storms in urban areas with modern fire-resistant buildings continued to be believed to be unlikely, and, in the case of other types of structures, continued to be seen as depending on their density (20-30 or more percent), as well as on wind speeds and humidity conditions.³² Fire storms in the areas of total destruction of buildings, i.e., the urban area subjected to 7 psi or greater blast overpressure, were believed to be unlikely. It was asserted that "fires do not occur in zones of complete destruction because the buildings ignited by thermal radiation are destroyed, the burning elements are scattered and covered by rubble. As a result, the rubble only smolders and strong fires do not occur."³³

As to fires in forests caused by nuclear detonations, one manual merely noted that,

*Large forest fires may occur as a consequence of the effects of thermal radiation. Fires in forests result from the burning of dry leaves, grass and dry wood. The spread of fire in forests depends on the time of the year and meteorological conditions. There is particularly great danger in the case of coniferous forests during dry summer weather. As a rule, deciduous forests, especially when their leaves have not yet fallen, do not catch fire as rapidly and burn with less intensity than coniferous forests.*³⁴

FOOTNOTES (Section 2)

1. Cited in Anne Ehrlich, Nuclear Winter: A Forecast of the Climatic and Biological Effects of Nuclear War, (Bulletin of the Atomic Scientist, 1984), April 1984, p. 11S.
2. For the medical implications of Soviet secrecy on possible war scenarios and projections of possible Soviet casualties, see L. Goure, The Soviet Civil Defense Medical Preparedness Program, Final Report, Science Applications, Inc., McLean, VA, March 1984, prepared for the Federal Emergency Management Agency under Contract No. EMW-C-0571.
3. Pravda, March 13, 1954.
4. The New York Times, December 9, 1953.
5. For example, see the speech by A.I. Mikoyan in Kommunist (Yerevan), March 12, 1954, quoted in H.S. Dinerstein, War and the Soviet Union, (New York, NY: Frederick A. Praeger, 1959), pp. 71-72.
6. Dinerstein, op. cit., pp. 72-77; A. Horelick and M. Rush, Strategic Power and Soviet Foreign Policy, (Chicago, IL: The University of Chicago Press, 1966), pp. 19-23; M.E. Miller, Soviet Strategic Power and Doctrine: The Quest for Superiority, (Washington, D.C.: Advanced International Studies Institute, 1982), pp. 26-28.
7. Izvestiya, April 27, 1954.
8. "The Peoples Decide the Fate of the World and Civilization," Kommunist, No. 4, March 1955, pp. 12-23, cited in Dinerstein, op. cit., p. 77.
9. Pravda, November 4, 1967.
10. Marshal of the Soviet Union A.A. Grechko, Na Strazhe Mira i Stroitel'stva Kommunizma (On Guard Over Peace and the Building of Communism), (Moscow: Voenizdat, 1971), p. 64
11. Colonel M. Shirokov, "Military Geography at the Present Stage," Voyennaya Mysl' (Military Thought), No. 11, November 1966, translated in FPD No. 0730/67, July 27, 1967, p. 59. See also, Shirokov, "The Question of Influences on the Military and Economic Potential of Warring States," Voyennaya Mysl', No. 4, April 1968, translated in FPD No. 0052/69, May 27, 1969, pp. 33-36.

12. Major General A.S. Milovidov, editor, The Philosophical Heritage of V.I. Lenin and Problems of Contemporary War, (Moscow: Voenizdat, 1972), translated by the U.S. Air Force in Soviet Military Thought Series, Vol. 5, pp. 127-128. See also Major General K. Bochkarev, "Nuclear Arms and the Fate of Soviet Progress," Sovetskaya Kirgiziya (Soviet Kirgiziya), August 25, 1970.
13. For example, see P. Zhilin and I. Rybkin, "Militarism and Contemporary International Relations," International Affairs (Moscow), No. 10, October 1972, p. 13; Yu. Molchanov, "The Leninist Policy of Peace," Ibid., No.2, February 1974, p. 5; V.G. Belgin, "Peaceful Coexistence and the Factors of Progress and Development," Voprosy Filosofii (Questions of Philosophy), No. 1, January 1974, p. 62; B.N. Ponomarev, speech at the USSR Academy of Sciences, May 19, 1975, Vestnik Akademii Nauk SSSR (Herald of the USSR Academy of Sciences), No.7, July 1975, p. 15.
14. Marshal of the Soviet Union A.A. Grechko, Krasnaya Zvezda (Red Star), March 28, 1973, and March 14, 1974.
15. Rear Admiral V. Shelyag, "Two Ideologies--Two Views of War," Krasnaya Zvezda, February 7, 1974; also Soviet Military Review, No. 11, November 1974, pp. 9-10.
16. Pravda, July 22, 1974.
17. L.I. Brezhnev, "Speech in Bucharest at the Soviet-Romanian Friendship Meeting," November 24, 1976, Pravda, November 25, 1976.
18. For example, see L.I. Brezhnev, speech at the USSR Supreme Soviet, Pravda, January 24, 1981, and speech in Kiev, Pravda, May 10, 1981.
19. Marshal of the Soviet Union N.V. Ogarkov, "Military Strategy," Sovetskaya Voyennaya Entsiklopediya (Soviet Military Encyclopedia), Vol. 7, (Moscow: Voenizdat, 1979), p. 564.
20. Pravda, March 23, 1984.
21. See Ye.I. Chazov, L.N. Ilyin and A.K. Guskova, The Danger of Nuclear War: Soviet Physicians' Viewpoint, (Moscow: Novosti Press, 1982), Appendix, pp. 133-135.
22. Ibid., p. 24.
23. Cited in Foreign Broadcast Information Service, Daily Report: Soviet Union, July 8, 1982, p. CC-7.
24. Ibid., pp. CC-7-CC-8.

25. For example, see L.A. Ilyin in Century and Peace (Moscow), No. 11, November 1982, pp. 21-23; Academician Ye.I. Chazov in "Hippocrates vs. the Bomb," Moscow News, No. 50, December 1982.
26. Chazov et al., op. cit., p. 100.
27. Ibid., p. 57.
28. A.S. Balayev, editor, Bor'ba s Pozharami na Obektakh Narodnogo Khozyastva v Usloviyakh Yadernogo Porazheniya (Firefighting at Installations of the National Economy Under Conditions of Nuclear Destruction), (Moscow: Voenizdat, 1973), p. 5.
29. Ibid., pp. 21-22.
30. Ibid., p. 33.
31. Ibid., pp. 17-18.
32. For example, see Colonels M.P. Tsivilev, A.A. Nikanorov, and B.M. Suslin, Inzhenerno-Spasatel'nyye i Neotlozhnyye Avariynno-Vorstanovitel'-nyye Raboty v Ochage Yadernogo Porazheniya (Engineering-Rescue and Emergency Repair and Restoration Work in Centers of Nuclear Destruction), (Moscow: Voenizdat, 1975), p. 27; P.T. Egorov, I.A. Shlyakhov and N.I. Alabin, Grazhdanskaya Oborona (Civil Defense), 3rd edition, (Moscow: Vysshaya Shkola, 1977), pp. 155-158; A.N. Krylov and V.G. Yukhimenko, Posobiye po Protivopozharnoy Sluzhbe Grazhdanskoy Oborony (Manual for the Firefighting Service of Civil Defense), (Moscow: Stroyizdat, 1981), pp. 76-79.
33. Egorov et al., op. cit., p. 46.
34. Ibid., p. 39.

SECTION 3

THE MAY 1983 MOSCOW CONFERENCE OF SCIENTISTS

3.1 THE CRUTZEN-BIRKS AMBIO PAPER

In 1982, the Swedish Royal Academy of Sciences published a collection of papers by Western scientists under the general title, "Nuclear War: The Aftermath" in its journal, Ambio. Included was an article entitled, "The Atmosphere After A Nuclear War: Twilight at Noon," by Paul J. Crutzen and John W. Birks, which warned that secondary fires from nuclear detonations could inject sufficient smoke and soot into the atmosphere to block 50 to 99 percent of the sunlight which normally reaches the surface of the earth.¹ The article generated a great deal of interest in the U.S. and Soviet scientific community. At the time of its publication, research at the National Academy of Sciences and of the TTAPS group was focused on the possible effects of dust raised by nuclear detonations on the climate.² The Crutzen-Birks article thus added a new and, up to then, largely ignored factor to the study of the possible climatic consequences of a nuclear war.

The Ambio nuclear war scenario assumed an exchange of about 5,700 megatons delivered by about 14,700 warheads, and included the targeting of most cities in the Northern Hemisphere with populations over 100,000, as well as military installations, C³, communications and transportation centers, key industrial and energy installations, refineries and oil fields, nuclear power reactors, etc. The nuclear strikes were estimated to kill outright 750 million persons and injure 340 million. Crutzen and Birks assumed that the detonations would start forest fires which would consume 10^6 km² of forests during a period of two months, and also set on fire large amounts of oil, as well as release gas and oil from broken production wells, equal to the current rate of worldwide usage. The resulting massive injection of smoke, tar and soot particles into the atmosphere was

estimated to reduce the amount of sunlight reaching the earth's surface by a factor of 2 to 150, and, consequently, much of the Northern Hemisphere would be darkened for a number of weeks. In addition, Crutzen and Birks predicted the production of ozone in the troposphere which, they believed, would cause a global photochemical smog and pose a further threat to the ecology.

There is reason to believe that Soviet scientists had known about the Crutzen-Birks project, which took two years to complete, prior to the publication of their findings in Ambio.

3.2 THE MAY 1983 ALL-UNION CONFERENCE OF SOVIET SCIENTISTS

On May 17-19, 1983, an "All-Union Conference of Scientists for Ridding Humanity of the Threat of Nuclear War, for Disarmament and Peace" was held in Moscow. It was attended by more than 500 Soviet scientists and some 50 foreign scientists and observers. When announcing the conference, Academician Ye. Velikhov, a vice-president of the USSR Academy of Sciences, indicated that one of its goals would be "to draw attention to the danger facing mankind as a consequence of the imperialist nuclear arms race policy. A scientific analysis of the biological, medical, ecological, and social consequences of nuclear war will feature prominently in the proceedings of the conference."³

The proceedings of the conference were reported in several ways. There were brief summaries of the main speeches reported in the Soviet press and some portions were broadcast on Moscow television. Some of the details were broadcast in English, but were not reported by the Soviet media for domestic consumption. Portions of the text of some of the papers were published in supplements in Moscow News, a Soviet English-language weekly in June 1983, and finally the papers were published in the Herald of the USSR Academy of Sciences in September 1983.⁴ Comparisons of these publications show some differences in the reported text of the papers which reflected

a Soviet sensitivity to the release of statements to domestic audiences, which may have been seen as implying too explicit a threat to the survival of the Soviet Union in the event of a war.

The political purposes of the conference were spelled out by B. Ponomarev, a candidate member of the Politburo and a secretary of the Party's Central Committee. Ponomarev told the conference that,

The duty of scientists--both natural and social scientists--consists, above all, in disclosing to humanity all the truth about the consequences of a nuclear war.

It is also the duty of scientists to tirelessly show the sources of the war danger. This task is especially relevant today because imperialist warmongers have never before applied such broad efforts to distort the true state of affairs, to deny their responsibility for the arms race, the war preparations, and to malign the policy of the countries that are fighting for peace.⁵

Ponomarev took note of the increasing international cooperation of scientists in the "peace" movement:

The traditional international scientific organizations, which have been doing useful work for peace and disarmament for several decades, are now increasing their activity. Among them are the Pugwash movement and the World Federation of Scientific Workers. They have now been joined by a new international organization, the Physicians for the Prevention of Nuclear War, an organization in which well-known Soviet medical men are working fruitfully, deserves special mention.⁶

Ponomarev's marching orders to the scientists were: First, they should continue to "demonstrate the grave consequences of a nuclear war" and "show how false and dangerous are the notions of a

'limited' or 'protracted' nuclear war." Second, the scientists should "expose the ruses and wiles of the opponents of disarmament," and reveal the deceptions of the U.S. "zero option" and of the "interim proposal" as applied to medium-range nuclear weapons. Third, they must "combat efforts to split and weaken the anti-war movement, to impose upon it false political doctrines such as the idea of 'equidistance' from the USSR and the USA, of the 'equal responsibility' of NATO and the Warsaw Pact Organization for worsening the international situation," and expose the "Pentagon-inspired false pseudo-scientific studies about a 'military threat' from the Soviet Union." Fourth, the scientists were told to make more energetic efforts to break down the barriers to international economic and cultural cooperation.⁷ As to the possible consequences of nuclear war, Ponomarev merely mentioned that a war with modern weapons "threatens the existence of human civilization itself."⁸

The papers read at the conference ranged over various topics relating to the danger of a nuclear war and the need to prevent it. The speakers cited a number of war scenarios in support of their arguments, all of which were borrowed from Western sources. These included the 1982 Ambio scenario, the 1975 U.S. Academy of Sciences scenario, the scenario used in the 1978 report of the United Nations Committee on the Effects of Atomic Radiation, and the scenario used in the study on the "Effects of Nuclear War on Health and Health Services" by S. Bergstrom et al., prepared for the U.S. World Health Organization in 1983.

Consequently, different projections of possible casualties and damage were presented. For example, the president of the USSR Academy of Medical Sciences, N.N. Blokhin, citing the U.N. report, said,

To calculate the medical consequences of a total thermonuclear catastrophe for the world's population, we accept the scenario in which the 10,000 megatons of the

nuclear strikes are distributed as follows: 90 percent for Europe, Asia and North America; 10 percent for Africa, South America, Australia and Oceania. The number of nuclear explosions was taken in proportion to the population numbers on each continent; 50 percent of the nuclear strikes [i.e, detonations] were in the air (over large cities) and 50 percent were [on] the ground, on land.

The result: in the event of a total thermonuclear catastrophe, the direct effects of nuclear weapons alone will spell the death of a third of mankind; in other words, the sum total of the victims will exceed 2 billion.⁹

Blokhin went on to establish a claim to the coincidence of Soviet and Western estimates of casualties, not surprisingly when using the same scenario. Thus, he asserted that:

*The figures obtained by Academician L.A. Ilyin, member of the USSR Academy of Medical Sciences, are confirmed by the findings of the British scientist, G. Rotblat, who has made independent projections in accordance with the same scenario.*¹⁰

By contrast, in discussing the long-term biological consequences of a nuclear war, Academician A. Bayev, the Academic Secretary of the Department of Biochemistry, Biophysics and the Chemistry of Physiologically Active Compounds of the USSR Academy of Sciences, cited the Ambio scenario.¹¹

Although various speakers cited the Ambio scenario, only a few touched on the topic of the possible effects of a nuclear war on climatic conditions which Crutzen and Birks had brought to public attention. One of the participants, L.P. Feoktistov, a corresponding member of the USSR Academy of Sciences, discussed the possibility of forest fires and said that a 1 MT warhead exploded above a

forest could ignite an area on the order of $1,000 \text{ km}^2$ containing 10 million m^3 of wood, in which event "the heat released from the fire would be dozens of times greater than the energy of the explosion." According to Feoktistov:

The bombs stockpiled in the USA, to use general parameters for a specific part of land, would be sufficient to burn out all the forests in the Soviet Union... The ashes which would be raised into the upper layer of the atmosphere would cloud the sun for all people on Earth.¹²

This statement by Feoktistov was not mentioned by the Soviet domestic public media. In the text published in the Herald of the USSR Academy of Sciences it was changed to read that the United States has a stockpile of nuclear weapons sufficient "to burn up forests over an area of 10 million km^2 ."¹³ Feoktistov noted that many effects of a total nuclear war "cannot be sufficiently accurately forecasted and estimated or 'simulated' in laboratories," but, he warned, without offering any evidence in support, the secondary effects of a nuclear war would destroy the earth's ecosystem.

The president of the Turkmen SSR Academy of Sciences, A.G. Babayev, also warned about the possible destruction of the earth's ecosystem. He pointed out that:

Every megaton of a nuclear charge [i.e., warhead] will inject 1,000 to 10,000 tons of dust into the stratosphere, where dust particles will act as nuclei for cloud formation. A 10,000 megaton strike can lower the Earth's surface temperature by several tenths of a degree Centigrade for 1-3 years.¹⁴

Babayev did not provide any model or calculations in support of this statement. He did cite, however, calculations by the U.S. National Academy of Sciences concerning the possible depletion of the ozone

layer as a result of nuclear detonations by 30 to 70 percent, adding "I won't judge the accuracy of the estimate."

The only paper given at the conference which specifically addressed the possible climatic consequences of a nuclear war was one by G.S. Golitsyn, a corresponding member of the USSR Academy of Sciences. The paper was said to be co-authored with Academician A. Obukhov, the director of the Institute of Atmospheric Physics of the USSR Academy of Sciences. Golitsyn's own specialty was in the field of Martian dust storms. It should be noted that in a paper released later in 1983, Golitsyn wrote that his model "also agrees well with many conclusions of the detailed computations of Turko et al., [presumably TTAPS, given the way Golitsyn referenced his sources] with which we first became acquainted in the Spring of 1982 [sic]."¹⁵ It is possible that Golitsyn meant the Spring of 1983 not 1982, given that the TTAPS findings had been presented for comments to groups of scientists in April 1983. In his paper, Golitsyn noted, concerning the effects of nuclear detonations, that:

Up till now, the main attention in this field was paid to the influence on the ozone layer of the atmosphere. The study of the other chemical processes in the atmosphere with its changed composition caused by explosions and massive urban and forest fires has begun of late. Furthermore, the nuclear explosions and fires will noticeably change the reflecting capacity [albedo] of the land surface and introduce a huge amount of substances into the atmosphere, substantially changing its optical properties. This will, in turn, alter the character of the atmospheric circulation and will eventually lead to substantial climatic effects, both on the regional and global scale.¹⁶

Golitsyn went on to point out that:

Numerical models of the circulation of the atmosphere with due account of the above-

mentioned chemical, optical and other changes are necessary for estimating the total effect. Such models do not exist in the world today.¹⁷

In his paper, Golitsyn made no attempt to offer a coherent picture of the effects of nuclear detonations and offered no new data or scenarios. Instead, he discussed several factors and phenomena, such as dust, the depletion of the ozone layer, and the effects of fires, independently of each other. In dealing with the question of the effects of dust and of nitric oxides on the ozone layer, he assumed the detonation an aggregate 10,000 megatons. His data appeared to be derived from earlier published American studies such as the 1975 Academy of Sciences study. Golitsyn noted that "Recently a group of American scientists made a thorough and comprehensive analysis of the fall of the Tunguska meteorite on 30 June 1908 [in Siberia] ," whose detonation at an altitude of 6-9 km was estimated to be equivalent to some 6,000 megatons and was believed to have caused an approximate 30 percent depletion of the ozone layer.¹⁸ In his discussion of the effects of fires, Golitsyn--without referencing his source--drew on the Crutzen and Birks 1982 Ambio paper. Like the authors of that paper, he assumed forest fires consuming an area of 10^6 km and projected that the smoke would reduce the amount of sunlight reaching the Earth's surface by a factor of 2-150, resulting in "much colder air near the surface of the globe."¹⁹ Golitsyn concluded by saying that:

It is a fair guess that the existing estimates of the adverse effects of a nuclear conflict for the atmosphere are substantially belittled and do not embrace the entire complex of dangerous phenomena. Soviet scientists in [the sphere] of atmospheric physics are convinced that nuclear war means also a war against the environment to which irremediable damage will be done as a result of a nuclear conflict.²⁰

Golitsyn's findings were summarized in a broadcast released in English by the Soviet news agency, TASS, as follows:

The almost total destruction of the stratospheric ozone, huge forest fires, storms, smoke pollution of the atmosphere resulting in lengthy droughts on large territories, this is only a part of what may happen as a result of the nuclear conflict, the report says.²¹

On May 18, 1983, Pravda carried a lengthy report on the proceedings of the conference, with extensive quotations from the speeches by Ponomarev and Velikhov. Concerning the climatic effects of nuclear detonations, Pravda wrote that in addition to the prompt effects of such detonations,

It is also necessary to take account of the radioactive pollution of the soil, water resources, and the atmosphere; radioactive fallout will cost many lives after the end of the war. Finally, there is also the problem of the global consequences of a nuclear war. In this problem there are many aspects which are not completely clear--take, for example, the effect on the ozone layer and the extent of the atmosphere's opacity because of the enormous quantity of aerosols in the atmosphere as a result of explosions and fires.²²

The conference ended with a press conference held by the president of the USSR Academy of Sciences, A.P. Aleksandrov, the vice-president of the USSR Academy of Sciences, P.N. Fedoseyev and Velikhov, and with the adoption of an appeal to world scientists. Pravda's version of the press conference made no mention of the possible climatic effects of nuclear detonations. Instead, it focused on the need for cooperation among "fighters for peace" and for the "consolidation" of various national peace movements of scientists, as well as on condemnations of U.S. defense policies.²³

The appeal "To Scientists Throughout The World" adopted at the conference on May 19, 1983, also made no direct reference to the climatic effects of nuclear detonations. It asserted, however, that with the existence of nuclear weapon stockpiles with an aggregate yield "of more than 50,000 megatons," "the existence of human civilization and, maybe, life on earth is at stake."²⁴ The appeal criticized U.S. policies and praised Soviet "peace policies" and ended by stating:

*We appeal to the scientists of the whole world to unite their forces in order to protect universal peace, the common possession of all men, from the threat of nuclear destruction.*²⁵

In an obvious effort to facilitate the "cooperation" and "consolidation" of scientists for this purpose, the conference announced the organization of a Committee of Soviet Scientists for Peace and Against the Nuclear Threat, with Ye.P. Velikhov elected as its chairman. Velikhov thus became the senior Soviet spokesman representing the Soviet scientific community in the Soviet "peace campaign" and in contact for this purpose with foreign scientists and their organizations. He had extensive contacts with foreign scientists and had participated in various international conferences dealing with the effects of nuclear war; for example, the International Seminar on Nuclear War held in Erice, Italy, in August 1983, and a similar one organized by the Vatican's Academy of Sciences in September 1983. He gained additional credentials for this role by "organizing" in April 1983 an "Appeal to All Scientists of the World," signed by over 200 members of the USSR Academy of Sciences, criticizing President Reagan's so-called Strategic Defense Initiative of March 23, 1983.²⁶ This appeal made no mention of the possible climatic effects of nuclear detonations.

Overall, therefore, the May Moscow Conference revealed neither wide interest among Soviet scientists in the question of the possible effects of nuclear fires on climate, nor gave any indication of independent Soviet research on this problem. V.V. Aleksandrov, who soon thereafter developed

a three-dimensional model of the climatic consequences of nuclear war, did not speak at the conference. The few speakers who indicated awareness of the Crutzen-Birks 1982 Ambio paper gave no indication of having subjected the paper's scenario, assumptions, calculations, and conclusions to any critical reassessment or to have applied to them data derived from Soviet experiences with large forest, oil, and urban fires.

FOOTNOTES (Section 3)

1. P.J. Crutzen and J.W. Birks, "The Atmosphere After a Nuclear War: Twilight at Noon," Ambio, Vol. 11, No. 2-3, pp. 115-125. See also "Global Atmospheric Effects of Nuclear-War Fires," Physics Today, October 1982, pp. 17-20.
2. R.P. Turco, O.B. Toon, T.P. Ackerman, J.B. Pollack, C. Sagan, "The Climatic Effects of Nuclear War," Science, August 1984, p. 33. See also J.B. Pollack, O.B. Toon, T.P. Ackerman, C.P. McKay and R.P. Turco, "Environmental Effects of an Impact-Generated Dust Cloud: Implications for the Cretaceous-Tertiary Extinctions," Science, January 1983, pp. 287-289.
3. Moscow TASS, in English, April 27, 1983, cited in Foreign Broadcast Information Service (FBIS), Daily Report: Soviet Union, May 18, 1983, p. CC-1.
4. V.A. Kotel'nikov, editor, "Scientists Against the Threat of Nuclear War: Speeches of the Conference Participants," Vestnik Akademii Nauk SSSR (Herald of the USSR Academy of Sciences), No. 9, September 1983.
5. B. Ponomarev, "The Role of Scientists in Strengthening International Security," Supplement to Moscow News, No. 24, June 18-23, 1983, p. 2.
6. Ibid., p. 5.
7. Ibid.
8. Moscow Television, May 17, 1983, cited in FBIS Daily Report: Soviet Union, May 18, 1983, p. CC-3.
9. Academician N.N. Blokhin, "A Real Threat to the Existence of Mankind," Supplement to Moscow News, No. 24, June 18-23, 1983, p. 2.
10. Ibid.
11. Academician A. Bayev, "The Remote Consequences of Nuclear War: A New Spiral of the Evolution of the Human Species Will Be Made Impossible," Supplement to Moscow News, No. 23, June 12-17, 1983, p. 7.
12. L. Feoktistov, "Nuclear Weapons: Super-Dangerous Factor," Supplement to Moscow News, No. 23, June 12-17, 1983, p. 6.

13. Kotel'nikov, op. cit.
14. A. Babayev, "Will Our Planet Become A Radioactive Desert?" Supplement to Moscow News, No. 24, June 18-23, 1983, p. 5.
15. G.S. Golitsyn and A.S. Ginzburg, Comparative Estimates of Climatic Consequences of Martian Dust Storms and Possible Nuclear War (Moscow: Institute of Atmospheric Physics of the USSR Academy of Sciences, 1984), p. 3 (emphasis added).
16. A. Obukhov and G. Golitsyn, "Earth Atmosphere: Catastrophe After Nuclear Strike," Supplement to Moscow News, No. 24, June 18-23, 1983, pp. 2-3.
17. Ibid., p. 3.
18. Kotel'nikov, op. cit.
19. Obukhov and Golitsyn, "Earth Atmosphere: Catastrophe After Nuclear Strike," op. cit., p. 3. In the Vestnik Akademii Nauk SSSR version of the speech, Golitsyn predicted the cooling of the surface air by "several dozen degrees."
20. Ibid.
21. Moscow, TASS, in English, May 18, 1983, cited in FBIS, Daily Report: Soviet Union, May 18, 1983, pp. CC-5-CC-6.
22. "Nuclear War is a Crime Against Mankind," Pravda, May 18, 1983.
23. "Belief in a Bright Future," Pravda, May 21, 1983.
24. Pravda, May 21, 1983.
25. Ibid.
26. Pravda, April 10, 1983.

SECTION 4

THE SOVIET MODELS

An article published in Moscow News in April 1984 devoted to the "Nuclear Winter" hypothesis and "What Soviet and American Scientists Know and Think About It," states that,

Climatic models of varying degrees of complexity were used independently by American and Soviet scientists--Carl Sagan's group from Cornell University [i.e., TTAPS], the specialists from the US National Center for Atmospheric Research headed by Steve Schneider, scientists Vladimir Aleksandrov and Georgi Stenchikov from the Computing Center of the USSR Academy of Sciences, and Georgi Golitsyn and Alexander Ginzburg from the Institute of Atmospheric Physics of the USSR Academy of Sciences--but they produced practically identical pictures.¹

4.1 THE ALEKSANDROV-STENCHIKOV MODEL

The first Soviet model, a three-dimensional one, of the possible climatic effects of a nuclear war, authored by V. Aleksandrov and G. Stenchikov of the Laboratory of Climatic Models of the Computing Center of the USSR Academy of Sciences, appeared soon after the May 1983 All-Union Conference of Scientists. Aleksandrov was the chief of the Laboratory of Climatic Modeling of the Computing Center, a post which--as he told the author of this paper in a private conversation in August 1983--he had reluctantly accepted a year earlier, i.e., about the time of the publication of the 1982 Ambio report on "Nuclear War: The Aftermath." Aleksandrov is an applied mathematician and, as he told this author, his team was made up of some 20 mathematicians and computer scientists "and not a single meteorologist." He has spent some eight months in the United States and had many contacts among American scientists. Furthermore, he was the only Soviet scientist present at the preliminary meeting in

Cambridge, Mass., in April 1983 when the TTAPS study was presented for the first time to a select group of physical scientists.²

The Aleksandrov-Stenchikov study offers an interesting instance of Soviet use of Western scenarios, data and also, in this case, of computer models. Thus, as the authors acknowledge:

*The climate model of the Computing Center of the USSR Academy of Sciences consists of the Two-Level Mintz-Arakawa model of the global circulation of the atmosphere and the thermodynamic model of the upper ocean. The atmospheric model, based on the well-known version of Gates et al. (1971), has the geographic resolution equal to 12° along the latitude and 15° along the longitude.*³

The report references W.L. Gates, E.S. Batten, A.B. Kahle and A.B. Nelson, "A Documentation of the Mintz-Arakawa Two-Level Atmospheric General Circulation Model," published by the Rand Corporation (Santa Monica, CA) in 1971.

The authors also state that:

*This report deals with the calculation of the evolution of the quasiequilibrium state of the joint ocean-atmospheric-land system under the instant change of the optical properties of the atmosphere in the Northern Hemisphere. This change is induced by the nuclear dust ejected by the surface and near-surface nuclear explosions and by the soot emitted by the urban fires, the fires of fuels and the wild [i.e., forest and grass] fires. The parameters of the atmospheric pollution [were] chosen in accordance with the estimations of this value after the nuclear conflict (Ambio, 1982).*⁴

Furthermore, the report notes that:

The estimations of the processes of the pollution of the atmosphere by the dust and soot show the strong change in the optical properties of the atmosphere [will] persist for a long time (Ambio, 1982). The main amount of the dust is lifted up to the atmosphere mechanically during the surface and near-surface bursts (Glasstone and Dolan, 1977). The fireballs of the nuclear bursts create the mass fires. During these the troposphere is polluted by soot which [is] formed by the incomplete burning of plastics, fuel, housing, industrial plants, forests, etc. (Crutzen and Birks, 1982; Broido, 1960).⁵

As these statements and the report's bibliographical references indicate, the scenario and the parameters which Aleksandrov and his colleagues applied to their Mintz-Arakawa model of atmospheric circulation were borrowed uncritically from Western sources.⁶ Indeed, later in 1983, Aleksandrov acknowledged that his work and the scenario he used were "inspired by my participation in a Cambridge meeting in April 1983,"⁷ at which the TTAPS study had been initially presented, and that he had used "the scenario of the change of the optical thickness suggested by the Sagan group" (TTAPS), i.e., the baseline scenario of the TTAPS study.⁸ Obviously, the development of the Aleksandrov-Stenchikov model had been a crash effort because Aleksandrov was ready to present it at the International Seminar on Nuclear War in Erice, Italy, in August 1983.

Aleksandrov and Stenchikov, therefore, made no attempt to use an independently developed scenario or to provide new values of the parameters essential to the "Nuclear Winter" hypothesis. Nor did they attempt to validate the values of the parameters they took from the Crutzen-Birks and TTAPS studies. All they did was use their model of atmospheric circulation to estimate--on the basis of these borrowed inputs--the possible changes in temperature in

various large regions of the world. Their only startling and most controversial prediction was that the solar heated soot cloud would increase the temperature of the middle troposphere and thereby heat the high mountains and plateau areas, causing rapid melting of glaciers and snow, while at the same time suppressing normal precipitation.

In the judgment of American scientists, including members of the TTAPS group, the Aleksandrov-Stenchikov model as a contribution to the "Nuclear Winter" hypothesis left much to be desired. In his Foreign Affairs article Carl Sagan noted that "It would be helpful to perform accurate three-dimensional calculations of the general atmospheric circulation following a nuclear war."⁹ However, in a footnote he characterized the Aleksandrov-Stenchikov model as a "still very crude three-dimensional simulation."¹⁰ More recently a leading contributor to the TTAPS study, Dr. Richard P. Turco, called the Aleksandrov-Stenchikov study "a very weak piece of work, crude and seriously flawed" and "a primitive rendition of an obsolete US model."¹¹ A similar assessment was made by Dr. Starley L. Thompson of the National Center for Atmospheric Research,¹² who had co-authored with Curt Covey and Stephen H. Schneider a paper on "Global Atmospheric Effects of Massive Small Injections from a Nuclear War: Results from General Circulation Model Simulations," in December 1983.

It must be said that prior to November 1983, Velikhov in his public statement did not unreservedly embrace and support the Aleksandrov-Stenchikov model and its findings. Indeed, he exercised considerable caution in dealing with the "Nuclear Winter" issue by citing the many uncertainties associated with it. For example, in an article published in August 1983, he wrote:

A crucial problem is that of global after-effects of nuclear war--of a global nuclear conflict with a counterforce component--and its impact on the delicate

balance of the earth's biosphere and the genetic foundation of life. Of course there are still many question marks in this problem; for example, impact on the ozone layer, the degree of opacity of the atmosphere caused by enormous amounts of aerosols released by explosions and fires."¹³

At the International Seminar on Nuclear War, which was held in Erice, Italy, in August 1983, Velikhov did not discuss Aleksandrov's work. However, when in a private conversation he was asked by the author why the Soviets were not providing independent data, he replied "we use your data, we just interpret it our way."

4.2 THE GOLITSYN-GINZBURG MODEL

As was noted, a second model of the climatic consequences of a nuclear war was developed by G.S. Golitsyn, a corresponding member of the USSR Academy of Sciences and Chief of the Climatology Laboratory of the Institute of Atmospheric Physics of the USSR Academy of Sciences, and A.S. Ginzburg of the same institute.¹⁴ Their findings were presented at the Conference on "The World After Nuclear War" held in Washington on October 31-November 1, 1983, at which the TTAPS study was made public. Some aspects of Golitsyn's study had been published in September 1983 in the Herald of the USSR Academy of Sciences in Russian.¹⁵

The Golitsyn-Ginzburg model is derived from the study of Martian dust storms. The authors claim that there are "many similarities between the evolution of a Martian dust storm and its effects on the thermal regime of the atmosphere and surface and the consequences of a possible nuclear war."¹⁶ According to an article in Moscow News,

Carl Sagan in the USA and Soviet scientists Georgi Golitsyn and Alexander Ginzburg, by studying a model of the dust

storms on Mars, have arrived at similar results about the changes threatening the atmosphere in the event of war.¹⁷

Golitsyn and Ginzburg also claim "good agreement between the results" of their model and those of "a much more detailed model by Pollack et al. (1983) speculating on the possible fate of an asteroid and the resulting injection of dust into the atmosphere as a cause of the mass extinction of various species some 65 million years ago."¹⁸ Furthermore, as has already been mentioned, the authors also claimed agreement "with many conclusions of the detailed computations of Turco et al., (1983), with which we first become acquainted in the Spring of 1982."¹⁹

Indeed, Sagan has pointed out that a "rough analogy can be drawn" between the large dynamical perturbation of the atmosphere which "would be expected in the aftermath of a nuclear war" as a result of the injection of large amounts of aerosols into the atmosphere and the "evolution of global-scale dust storms on Mars." In particular the claimed analogy allowed the projection of inter-hemispheric transport of aerosols in the upper troposphere and stratosphere.²⁰ In their model, Golitsyn and Ginzburg use, as they write, "the simplest model of the radiative atmosphere and the underlying surface," which considers "the parts of the system as two layers with two different temperatures."²¹

Aside from the extrapolations from Martian dust storms, Golitsyn and Ginzburg demonstrated the same lack of independence and originality as Aleksandrov and Stenchikov in the matter of inputs of scenarios and the effects of nuclear detonations. For example, Golitsyn and Ginzburg make clear that they used the assumptions and values of the smoke parameters developed by Crutzen and Birks in their 1982 Ambio paper. Thus, in their discussion of the initial consequences of a nuclear war they state that:

To estimate the influence on the atmosphere of the thermal energy released by fires, we restricted ourselves to taking into account only forest fires in an area of 106 km², as was conservatively supposed by Crutzen and Birks.²²

Again, in their estimates of the changes in the thermal regimes of the atmosphere as a consequence of a nuclear war, Golitsyn and Ginzburg write:

We shall consider dust storms on Mars which are sufficiently well documented, the hypothetical fall of a small asteroid on Earth about 65 million years ago (Pollack et al., 1983) and the consequences of numerous fires (Crutzen and Birks, Ambio, 1982).²³

The reference section of the Golitsyn-Ginzburg paper also shows heavy reliance on Western sources. Thus, of the 38 cited sources, 15 are Soviet and 23 Western sources. Of the Soviet sources at least five deal with studies of Martian and Venusian weather, and none, except for Golitsyn's own September 1983 paper, deal specifically with the effects of fires and dust from nuclear detonations.²⁴

Of course, neither Aleksandrov and Stenchikov nor Golitsyn and Ginzburg were concerned with attempting to develop for use in their models, independent scenarios or values of essential parameters characterizing fires and particulates. They only sought to provide mathematical simulations of the global atmospheric circulation and its effects on the aftermath of a nuclear war while taking the TTAPS and Crutzen-Birks projections of a "Nuclear Winter" effect for granted. Given the similarity of the inputs, it is not surprising that both models arrived at "predictions" of a "Nuclear Winter" effect very similar to that of the TTAPS study and, consequently, gave the appearance of "confirming" the latter's validity.

In fact, however, neither Soviet model is perceived in the West as making a significant contribution to the study of the "Nuclear Winter" hypothesis. In the case of Aleksandrov and Stenchikov, their model and its findings are believed to be too crude and flawed to be of real value. In the case of Golitsyn and Ginzburg, their model is too simple, and the analogy of Martian dust storms and post-war atmospheric conditions on Earth remains speculative. Except for some kind words by Sagan, the Golitsyn-Ginzburg model appears to have been disregarded in the West. Of the two, the Soviets appear to have given greater public play to the Aleksandrov-Stenchikov model, and Aleksandrov has been an indefatigable presenter of it at international conferences, especially those held in the West, devoted to discussion of the consequences of a nuclear war.

FOOTNOTES (Section 4)

1. V. Kyucharyants, "Nuclear Winter," Moscow News, No. 13, April 5-15, 1984, p. 5. (emphasis added).
2. See Anne Ehrlich, Nuclear Winter, A Forecast of the Climatic and Biological Effects of Nuclear War, (Bulletin of the Atomic Scientist, 1984), p. 13S.
3. V.V. Aleksandrov and G.L. Stenchikov, On the Modelling of the Climatic Consequences of the Nuclear War, (Moscow: The Computing Center of the USSR Academy of Sciences, 1983), p. 3.
4. Ibid, p. 4-5. (emphasis added)
5. Ibid, p. 10.
6. Ibid, "Literature", pp. 11-12 cites only six sources, of which five are Western: V.V. Aleksandrov, P.L. Arkhipov, V.P. Perkhomenko and G.L. Stenchikov, "The Global Model of the Ocean-Atmospheric System and the Study of its Sensitivity to the CO₂ Discharge into the Atmosphere," Proceedings of the USSR Academy of Sciences, "Physics of Atmosphere and Ocean," Vol. 19, No. 5, 1983; "Nuclear War: The Aftermath," Ambio, 1982; A. Broido, "Mass Fires Following Nuclear Attack," Bulletin of the Atomic Scientist, Vol 16, 1960; P.J. Crutzen and J.W. Birks "The Atmosphere After a Nuclear War: Twilight at Noon," Ambio, Vol. 11, 1982; W.L. Gates et al., "A Documentation of the Mintz-Arakawa Two-Level Atmospheric General Circulation Model," R-877-ARPA, The Rand Corporation, Santa Monica, CA, 1971; S. Glasstone and P.J. Dolan, The Effects of Nuclear War, US Department of Defense, 1977.
7. P.R. Ehrlich, C. Sagan, D. Kennedy, W.O. Roberts, The Cold and the Dark; The World After Nuclear War, (New York, NY: W.W. Norton & Company, 1984), p. 95.
8. Ibid; V.V. Aleksandrov, paper given at Senators E. Kennedy and M. Hatfield hearing on the "Joint American-Soviet Scientist Forum on Nuclear War," Washington DC, December 8, 1983. See also "Atmospheric Calculations Suggest a Nuclear Winter," Physics Today, February 1984, p. 19.
9. Carl Sagan, "Nuclear War and Climatic Catastrophe: Some Policy Implications," Foreign Affairs, Winter 1983-1984, p. 268.
10. Ibid., p. 281.
11. "Soviets Offer Little Help," Science, July 1984, p. 31.

12. Ibid.
13. Academician Ye. P. Velikhov, "Science and the Prevention of Nuclear War," International Affairs, (Moscow), No. 8, August 1983, p. 27.
14. G.S. Golitsyn and A.S. Ginzburg, Comparative Estimates of Climatic Consequences of Martian Dust Storms and Possible Nuclear War, (Moscow: Institute of Atmospheric Physics of the USSR Academy of Sciences, January 1984).
15. G.S. Golitsyn, "Possible Atmospheric Consequences of a Nuclear Conflict," Vestnik Akademii Nauk SSSR (Herald of the USSR Academy of Sciences), No. 9, September 1983, p. 57-60.
16. Golitsyn and Ginzburg, op. cit., Introduction.
17. Kyucharyants, op. cit.
18. Golitsyn and Ginzburg, op. cit., p. 3. Reference is made to J.B. Pollack, O.B. Toon, T.P. Ackerman, C.P. McKay and R.P. Turco, "Environmental Effects of an Impact-Generated Dust Cloud: Implications for the Cretaceous-Tertiary Extinction," Science, January 1983, pp. 287-289.
19. Ibid.
20. R.P. Turco, O.B. Toon, T.P. Ackerman, J.B. Pollack, Carl Sagan, "Nuclear Winter: Global Consequences of Multiple Nuclear Explosions," Science, December 1983, p. 1289.
21. Golitsyn and Ginzburg, op. cit., p. 7.
22. Ibid., p. 4.
23. Ibid., pp. 13-14.
24. Ibid., References.

SECTION 5

THE OCTOBER 1983 CONFERENCE ON "THE WORLD AFTER NUCLEAR WAR" AND THE AFTERMATH

5.1 THE OCTOBER 1983 CONFERENCE ON "THE WORLD AFTER NUCLEAR WAR"

The Conference on "The World After Nuclear War," which met on October 31-November 1, 1983 in Washington, served not only as a platform for the public airing of the TTAPS study but also for the presentation of V. Aleksandrov's and G. Golitsyn's papers to a large Western audience. In addition, one of the highlights of the event was a dialogue between two groups of Soviet and American scientists via a closed-circuit television hookup between Washington and Moscow. In this dialogue, the American group was led by Dr. Thomas F. Malone and Dr. Carl Sagan and the Soviet group was led by Academician Ye.P. Velikhov.¹ Aside from the "anti-nuclear" and "anti-war" propaganda opportunities which this dialogue provided, it also offered the possibility to several Soviet scientists, who had not previously spoken to Western audiences on the "Nuclear Winter" issue, to state their views. It provided Soviet scientists with a further opportunity to give evidence of independent research on this problem. Actually, the main theme of the dialogue was to emphasize the coincidence of the TTAPS and Soviet findings. This Sagan underscored in his opening remarks by saying that the conclusions of the TTAPS study "are supported by a wide range of studies in both the United States and the Soviet Union."² As it happened, some of the Soviet scientists did attempt to give the impression that they were conducting independent research. However, their areas of apparent disagreement with the TTAPS study were essentially trivial and did not affect its prediction of a "Nuclear Winter" effect.

The Soviet scientist who first took the lead in this dialogue was Dr. Yu. Izrael, a corresponding member of the USSR

Academy of Sciences and head of the Committee for Hydrometeorology and the Control of the Environment. Izrael listed five consequences of nuclear war: global radioactive fallout, "pollution of the atmosphere by an enormous amount of aerosol particles" composed of dust and soot, pollution of the atmosphere by gaseous products of fires, depletion of the ozone layer, and "change in the albedo of the surface of the Earth."³ Izrael went on to say

In order to predict one of the greatest effects of the aerosol products, it is important to assess what quantity of aerosol particles will remain in the atmosphere for a long time. Tropospheric aerosols are short-lived--up to two weeks, approximately--so it is necessary to calculate what part of the high-dispersion aerosols will go into the stratosphere. According to our assessment, this portion will be about 1 percent. This is comparable to high-dispersion aerosols that go into the stratosphere during high-yield volcanic eruptions.

Undoubtedly, tropospheric aerosols will lead to a lowering of the temperature of the surface during the first weeks after the nuclear bursts. This in turn will have a catastrophic effect on the ecosystem and on the yield of agriculture.⁴

The difference between Izrael's projections and corresponding ones of the TTAPS study was that the latter assumed a longer persistence of the aerosols in the troposphere (in the TTAPS baseline case the optical depth due to tropospheric smoke after one month is still 2),⁵ and in its baseline case, that 5 percent of the soot would be projected into the stratosphere. The point, however, is that neither Izrael's estimate of persistent aerosols in the stratosphere nor that of TTAPS study are significant factors in producing the "Nuclear Winter" effect.⁶ In contrast, Izrael belittles the significance of differences in the aerosol mass produced, an essential ingredient of "Nuclear Winter" predictions:

I have questions on the distribution of particle size and quantities and sizes of aerosol particles injected into the atmosphere. For example, I can say that in our calculations of the quantity of high-dispersive aerosol particles we calculated about 1 percent or even less than 1 percent for sizes smaller than a micrometer. This figure, while it is probably close to that cited in your work, Dr. Sagan--I think you used 0.5 percent high-dispersity (small size) aerosols--is less than 1 percent. These are strictly scientific aspects...⁷

Dr. Izrael also made another point in which he appeared to diverge from the TTAPS study. He said that "of even greater consequence, from our point of view, is a possible subsequent (i.e., after the cooling) rise in temperature of the troposphere after the fallout caused by the absorption of long-wave radiation" as a result of the large injection of tropospheric ozone, carbon dioxide and other gases. This Izrael claimed could cause a "greenhouse effect" and result in "serious long-term changes in climate."⁸ Sagan had already discounted such an effect at the same conference.⁹

This issue was also raised by another participant in the dialogue, Dr. K. Kondratyev, a corresponding member of the USSR Academy of Sciences and former rector of the University of Leningrad. Kondratyev pointed out that high altitude measurements following the 1962-1963 nuclear tests had shown that gaseous nitrogen dioxide (NO_2) generated by the tests had absorbed solar radiation which "might have been responsible for half a degree cooling." He went on to say: "then we used the scenario published in Ambio in 1982 and extrapolated to see what would happen in a case of nuclear war. The results showed a global cooling of 9.5 degrees Centigrade, which is, of course, significant in itself." Kondratyev warned that the build-up of NO_2 in the stratosphere would make this a "long-term phenomenon."¹⁰ However, Western scientists have been dubious about the possibility of such an effect.

While the statements by Izrael and Kondratyev appeared to indicate that some independent calculations on certain rather narrow aspects of the problem may have been carried out by Soviet scientists, none of the Soviet participants suggested that they had used independently developed scenarios or different values of parameters of dust and smoke emissions from nuclear detonations and fires from those of the TTAPS or Crutzen-Birks studies. As one would expect, all agreed that a nuclear war was likely to produce a "Nuclear Winter" effect.

One interesting occurrence at the conference was an appeal by Sagan to the Soviet scientists for data. Sagan, noting that "there is a range of uncertainties in these studies," asked:

*Do our Soviet colleagues think it possible that they might supply data on the particle size distribution function of debris from Soviet nuclear weapon tests before the 1963 Limited Test Ban Treaty, and information on particle sizes and absorption coefficients from large fires in the Soviet Union? Also, will they eventually give us a range of nuclear war scenarios that they consider likely?*¹¹

The question was followed by "a tense pause."¹² Finally, Izrael responded by saying that "our dialogue and discussions...should be continued" and noted that he too had questions for his American colleagues.¹³ This was the only Soviet response to Sagan's questions. In his concluding remarks, as the leader of the Soviet group of scientists, Velikhov ignored Sagan's request altogether. However, Academician R.Z. Sagdeyev, director of the Institute of Cosmic Studies of the USSR Academy of Sciences said:

I think we should agree to have very close cooperation on the further development of these models. Perhaps the data we have obtained from nuclear tests over the past decade [sic], for example, in the

dispersion and the composition of aerosols, can be used in these studies.... We have observations not only of volcanic activity, which ejects aerosol particles, but also of solar flares which bring about changes in the stratosphere--for example, the creation of nitrous oxides. I believe if we were to make this a joint activity and employ new planetary methods, particularly using space technology, it would be very useful.¹⁴

By coincidence the same day, November 1, 1983, appeared an article by Velikhov in the Soviet newspaper Moscow Pravda. In it Velikhov wrote:

Although the consequences of a global nuclear war cannot be predicted with full confidence--for obvious reasons they cannot be verified by experiments--we still possess sufficient information obtained from the study of immediate and long-term consequences of the nuclear destruction of the populations of Hiroshima and Nagasaki, weapon tests, and calculations.¹⁵

Velikhov appeared to suggest that existing data and "calculations" were sufficient for the purposes of predicting the possibility of catastrophic consequences of nuclear war and for lending support to Soviet political objectives. As he put it, when speaking to the Washington conference on November 1, "the Conference is a very important step; perhaps it will indeed give new impulse in the direction of nuclear disarmament."¹⁶ According to Velikhov, with the "scientific results, data and information provided at the conference, anybody or everybody should be able to make practical deductions." One of these deductions was that "even the use of a small portion of the nuclear arsenals would bring about catastrophic results." Apparently, Velikhov was all too willing to uncritically endorse the TTAPS war scenarios because they demonstrated, as he said, "that all kinds of [US] policy positions on local or so-called 'limited' war, counterforce strikes, 'controlled' war,

flexible response, protracted war become--in the light of what we now know--totally baseless."¹⁷

The Soviet press gave only limited play to "The World After Nuclear War" conference. For example, according to Pravda's brief account of the conference,

*The screen showed our planet, towards which a dark cloud was advancing, spreading over its entire surface. Diagrams showed how far the dust raised by a nuclear blast will cover the sky, blocking the sun's rays. Charts showed a sharp drop in the temperature on the Earth's surface and a steep increase in the level of radiation. The report's language was precise, their conclusion was terrible. Those who do not die in the first minutes of a "nuclear exchange" can expect no better fate.*¹⁸

The article concluded by criticizing the US Administration's militaristic policies and by proclaiming that "The Conference has shown that the thunder of the military drums cannot muffle the voices of reason."

5.2 THE KENNEDY-HATFIELD JOINT AMERICAN-SOVIET SCIENTIFIC FORUM ON NUCLEAR WAR

On December 8, 1983, Senators E. Kennedy and M. Hatfield held hearings at a "Joint American-Soviet Scientific Forum on Nuclear War" organized by the Nuclear Freeze Foundation. The "witnesses" on the American side were Dr. Carl Sagan, Dr. Lewis Thompson, Dr. Paul Ehrlich and Dr. Jack Geiger; and on the Soviet side Academician Ye.P. Velikhov, Dr. V. Aleksandrov, Dr. S. Kapitsa, the latter a professor of physics and a senior research fellow at the Institute of Physical Problems of the USSR Academy of Sciences, and Dr. H. Pavlov, a member of the USSR Academy of Medical Sciences. All the Soviet panelists made presentations.

In his statement, Velikhov listed several factors which, he said, intensify the consequences of nuclear detonations. One of these is the destruction of nuclear power plants; the other, fires. According to Velikhov:

*Fires intensify considerably the energy discharge as fuel reservoirs, areas of cities and industrial centers, as well as woodstocks accumulate energy dozens of times as much as that of nuclear warheads.*¹⁹

Among the most dangerous consequences of nuclear detonations, Velikhov said, "is the initiation of [the] so-called "Nuclear Winter" due to breaking [the] solar energy flow which falls on the Earth's surface, and cardinal, explosive change of climate." Velikhov went on to assert that:

*Estimations of Soviet and American scientists show that climatic changes, that is "Nuclear Winter," can arise on exploding 100 MT of nuclear equivalent. This is by two orders [of magnitude] less than [the] stockpiled [nuclear] potential.*²⁰

Velikhov thus picked up the 100 MT TTAPS scenario without noting in his statement that this scenario assumed strikes with 0.1 MT warheads on 1,000 large cities and their optimal burning.

Aleksandrov went through a standard presentation of his model. However, as has already been mentioned, he acknowledged using "the scenario of the change of optical thickness suggested by the Sagan Group (TTAPS, 1983)."²¹ Aleksandrov's conclusion was that "after a nuclear war, practically regardless of its scenario, the survivors of the first strike would find themselves in conditions of severe cold, lack of water, food and fuel, affected by powerful radiation, pollution, and diseases...in twilight and darkness."

Kapitsa began his presentation by declaring that:

Recent research on the global consequences of nuclear war raises a number of questions that have to be discussed in order to put these remarkable findings in their proper place. The main result is that even if 1/3 of all [nuclear] weapons are used, the changes in the climate lasting for some months will drastically affect life on our planet.²²

Unlike Velikhov and Aleksandrov, Kapitsa attempted to discuss the issue of "the extent to which these results [i.e. projections] are reliable and valid."

It is well known that the proof of any scientific theory, calculation or conjecture is in experience, in trying the thing out. This standard approach is certainly ruled out, although a number of tests of these calculations have been made: for example, we can study the impact of volcanic eruptions, injections of dust and soot into the atmosphere of the earth. Next is the correspondence of the work done by different groups working on these problems. A detailed professional discussion of this work at the recent Conference on "The World After Nuclear War" here in Washington has unequivocally shown general agreement in all the main points.²³

Given that the Soviet scientific spokesmen had used the same scenarios, data and values of essential parameters of the effects of nuclear detonations as their American colleagues, the resulting "general agreement," while not surprising, did not constitute proof of the "validity and reliability" of the "Nuclear Winter" hypothesis.

Kapitsa also claimed that "these models" have identified a threshold for the start of the "Nuclear Winter" effect. In actual

fact only the TTAPS study had claimed to have done so. The Soviet models had not attempted to determine such a threshold. Surprisingly, Kapitsa asserted that "the threshold is around 500 to 1,000 MT, and depends on the pattern [in] which the bombs are exploded." Why Kapitsa had failed to cite the TTAPS 100 MT threshold which Velikhov had mentioned in his statement is not clear. The 1,000 MT number had appeared in the TTAPS study in the context that "Relatively large climatic effects could result even from relatively small nuclear exchanges (100 to 1,000 MT) if urban areas were heavily targeted."²⁴ However, in his Foreign Affairs article, Sagan had mentioned a crude threshold "very roughly around 500 to 2,000 warheads."²⁵ Possibly, Kapitsa had been confused by the two sets of TTAPS numbers on megatonnage and warheads.

The statements by the Soviet participants at the "Joint American-Soviet Scientific Forum" gave no indication of any new Soviet research or of independently developed scenarios or data. All four Soviet scientists, however, used the occasion to make political statements.

In its report on the forum, Izvestiya wrote:

*The idea that nuclear war would have catastrophic ecological consequences and would create a deadly threat to mankind itself and its civilization permeated the speeches of all the two countries' scientists without exception. The main result of this important forum's work is the identity of opinions expressed by the USSR and US representatives on the questions relating to the prevention of nuclear madness. With good arguments, in-depth analysis, and breadth of academic knowledge, they showed that a nuclear catastrophe and its consequences could be irreparable for the whole world.*²⁶

Izvestiya was especially gratified that both the American and Soviet participants had been unanimous in their public condemnations of "the nuclear first strike," the US arms build-up, plans for "Star Wars," and the alleged belief in the US that a nuclear war could be kept limited.

5.3 AFTER THE DECEMBER 1983 WASHINGTON FORUM

Following the Washington forum, Velikhov published several articles. These appeared, however, in Soviet English-language publications,²⁷ and none of them offered anything new. However, reporting on a conference of the Committee of Soviet Scientists for Peace and Against the Nuclear Threat held in March in Tallin, Estonia (USSR), Izvestiya claimed that:

...The scientists who addressed the session noted that, in a comparatively short space of time, fundamental research into the long-term global, climatic, biological, and other consequences of nuclear war has been carried out. The results of this work have attracted the attention of broad sections of the scientific community, statesmen, and politicians of various countries. The truth about the pernicious consequences of nuclear war has become public knowledge.²⁸

It was further asserted at the conference that:

Studies conducted by Soviet scientists have confirmed that even a local nuclear war will affect the entire population of the world, including inhabitants of countries not involved in the war, due to climatic, ecological, biological and socio-economic consequences of nuclear war.²⁹

If the Soviet scientists were conducting, as claimed, independent studies of the consequences of a nuclear war, there was

little evidence of it at the International Seminar of the Scientific Committee on Problems of the Environment (SCOPE) which met in Leningrad in May 1984. The star performer at the seminar appears to have been P.J. Crutzen from the Federal Republic of Germany who presented some new estimates of fire generated soot.³⁰ On the Soviet side V. Aleksandrov presented his model once again. This time, however, he had adapted it to the two limiting scenarios in terms of yields of the TTAPS study, the one in which 100 MT are detonated on 1,000 cities and the other in which 10,000 MT are detonated on a mix of targets.³¹ Not surprisingly, therefore, Aleksandrov came up with the same projections of a "Nuclear Winter" as the TTAPS study. As in his earlier paper, Aleksandrov used his model to project temperature declines for different regions of the world. He also continued to predict that the heating of higher elevations would could cause "a mass thawing of glaciers and floods on a continental scale," a prediction which Western scientists persisted in viewing with considerable skepticism. Dr. R.P. Turco, who attended the seminar, characterized the Aleksandrov presentation as a "rehash" of his previous work and as offering nothing new.³² Nor was there anything new in the papers given by other Soviet scientists.

FOOTNOTES (Section 5)

1. P.R. Ehrlich, C. Sagan, D. Kennedy, W.D. Roberts, The Cold and the Dark: The World After Nuclear War, (New York, NY: W.W. Norton & Co., 1984), pp. 133-134.
2. Ibid., p. 135.
3. Ibid., p. 138.
4. Ibid., p. 139, (emphasis added).
5. R.P. Turco, O.B. Toon, T.P. Ackerman, J.B. Pollack, and C. Sagan, "Nuclear Winter: Global Consequences of Multiple Nuclear Explosions," Science, December 23, 1983, p. 1285.
6. C. Sagan in "Comments and Correspondence," Foreign Affairs, Spring 1984, pp. 999-1000.
7. Ehrlich et al., op. cit., p. 147.
8. Ibid., p. 139, (emphasis added).
9. Ibid., p. 31.
10. Ibid., p. 145.
11. Ibid., p. 146.
12. Anne Ehrlich, Nuclear Winter: A Forecast of the Climatic and Biological Effects of Nuclear War, (Bulletin of the Atomic Scientist, April 1984), p. 115.
13. P.R. Ehrlich, et al., op. cit., p. 147.
14. Ibid., p. 149.
15. Ye.P. Velikhov, "Science on Behalf of Life or Earth," Moskovskaya Pravda (Moscow Pravda), November 1, 1983.
16. R.P. Ehrlich et al., op. cit., p. 151.
17. Ibid., p. 152.
18. G. Vasilyev, "Scientist's Imposing Word; Television Dialogue Across the Ocean," Pravda, November 16, 1983.
19. Statement by Academician Ye.P. Velikhov, Washington, D.C., December 8, 1983.

20. Ibid.
21. Statement by Dr. V. Aleksandrov, Washington, D.C., December 8, 1983.
22. Statement of S. Kapitsa, Washington, D.C., December 8, 1983.
23. Ibid.
24. Turco et al., op. cit., p. 1290.
25. Carl Sagan, "Nuclear Winter and Climatic Catastrophe: Some Policy Implications," Foreign Affairs, Winter 1983-1984, p. 275.
26. L. Koryavin, "USSR-USA: Scientists' Forum," Izvestiya, December 11, 1983.
27. Ye.P. Velikhov, "End Nuclear Insanity," Soviet Military Review, No. 1, January 1984, pp. 7-9; XX Century and Peace No. 2, February 1984, p. 1-4; "Humanity is Facing a Serious Challenge," Moscow News, February 12, 1984, p. 7.
28. "Nuclear Weapons Are the Common Enemy," Izvestiya, March 8, 1984.
29. Moscow TASS in English, March 6, 1984, cited in FBIS Daily Report: Soviet Union, March 7, 1984, p. AA-4.
30. Moscow TASS in English, May 15, 1984, cited in FBIS Daily Report: Soviet Union, June 6, 1984, p. AA-6.
31. Moscow TASS, May 15, 1984.
32. "Soviets Offer Little Help," Science, July 1984, p. 31.

SECTION 6

SOVIET RESEARCH ON "NUCLEAR WINTER" AND ITS IMPLICATIONS

Publicly, especially in international forums, Soviet scientific spokesmen have wholeheartedly embraced the "Nuclear Winter" hypothesis. If there are any divergent views in the Soviet scientific community, they have not been allowed to appear in the public discussion of this hypothesis. Such an apparent unanimity of views on a subject so fraught with uncertainties is suspect and suggests that the primary purpose of Soviet public activism in this matter is political rather than scientific.

This impression is reinforced both by the failure of Soviet scientists to respond to requests by the TTAPS group for data and by the low quality, and lack of, meaningful contributions by Soviet scientists to the public international study of the "Nuclear Winter" effect on the basis of independently developed scenarios and data.

Thus, the Soviets have so far failed to answer Sagan's request of November 1, 1983, for data derived from Soviet pre-1963 nuclear tests and large fires and also for Soviet views of likely war scenarios. Sagan had pointed out that such data would be useful for solving a range of uncertainties dealing with war scenarios, the amount of soot and dust which would be injected into the atmosphere, the agglomeration of particles in the atmosphere and the length of time for them to fall out, atmospheric circulation, and so on.¹ For unknown reasons, Dr. R.P. Turco and other Western scientists who had gone to the Leningrad International Seminar in May 1984 were reported to have been "highly optimistic about potential Soviet contributions."² They were said to have hoped to see data on Siberian forest fires and details of a "much discussed Soviet fire experiment," as well as to obtain unclassified information on Soviet atmospheric nuclear weapon tests. Instead, as Turco reported, "we sort of got a rehash of Aleksandrov's work." Nothing further has been forthcoming from the Soviet side.

Why the Soviets have failed to provide data from large fires is not clear. Massive forest and peat fires have occurred in the Soviet Union during the past decade and they certainly offered Soviet scientists the opportunity to study the particle size distribution generated by them and the absorption coefficient and refractive index of such particles. For example, massive fires had been reported in the Soviet press in 1972 in European Russia, in 1974 in Eastern Kazakhstan and Western Siberia, in 1975 in the Western Urals, in 1976 in Siberia--especially in the region of Chita where 275 fires were burning nearly simultaneously, and so on.³ It is also noteworthy that in the paper he presented in May 1983 at the All-Union Conference of Scientists in Moscow, Golitsyn cited American rather than Soviet research on the effects on the ozone layer of the 1908 explosion of the Tunguska meteorite in Siberia.

As far as independent Soviet work on the essential parameters of the "Nuclear Winter" hypothesis is concerned, so far none has been introduced into the discussion. As has been noted, neither the Aleksandrov-Stenchikov, nor the Golitsyn-Ginzburg models have contributed to the resolution of the various uncertainties mentioned by Sagan and his colleagues in the TTAPS study. Soviet scientists have failed to develop new scenarios or data on the key dust and smoke parameters which are so critical to the "Nuclear Winter" hypothesis. Instead, they have uncritically applied the parameters and values provided by Crutzen and Birks (Ambio, 1982) and by the TTAPS study to "crude" and "flawed" atmospheric circulation models. In the few cases the Soviet scientists have given the impression of independent work, these have dealt with peripheral issues such as that of the percentage of aerosols which will persist in the stratosphere, the possible absorption of solar heat by nitrogen dioxide in the stratosphere, or the claim that a greenhouse effect may follow the "Nuclear Winter." Thus, despite their efforts to give the impression of active--indeed, enthusiastic--support to and cooperation with the "Nuclear Winter" research work, in fact "the Soviet scientists," as Turco has noted, "have contributed little to

the international 'Nuclear Winter' study effort so far, and quite a few people are extremely disappointed."⁴ Furthermore, according to Turco, "there is no evidence of experimental planning" by Soviet scientists in the field of "Nuclear Winter" research.⁵

A possible indication of a lack of Soviet high-level seriousness or concern about the "Nuclear Winter" hypothesis is the absence, at least in public, of a coordinated interdisciplinary effort among Soviet scientific institutes to study this phenomenon. For example, in May 1983 Golitsyn of the Institute of Atmospheric Physics apparently did not know that V. Aleksandrov was developing a model at the Computing Center of the USSR Academy of Sciences, and there is no indication of any subsequent collaboration between this institute and the Computing Center. Yu. Izrael's computations were carried out independently of the Aleksandrov and Golitsyn work and had no influence on their assumptions. The same is true for K. Kondratyev's research and projections on the absorption of solar radiation by stratospheric nitrogen dioxide. In their turn, the various institutes for biological, environmental and medical studies appear to have gone their own way, each examining a distinct potential consequence of a nuclear war. In any event, the Soviet Union has not organized an interdisciplinary group of scientist comparable to the TTAPS team to study "Nuclear Winter." Meanwhile, the readiness of Soviet scientists to participate in Western studies of "Nuclear Winter" appears to be more intended to serve political rather than scientific purposes. Of course, the possibility cannot be excluded that the Soviets have organized a secret comprehensive effort to study "Nuclear Winter" and its implications.

Although the highest levels of the Soviet scientific community and of the USSR Academy of Sciences publicly claim to believe in the likely occurrence of a "Nuclear Winter" in the event of a nuclear war, there is no sign that this has had any influence on Soviet policies. In his comments in May 1984 at the Leningrad Seminar, the leader of the Soviet delegation of scientists, Dr. N.N. Moiseyev, a

corresponding member of the USSR Academy of Sciences and deputy director of its Computing Center, said, concerning the seminar's conclusions, that the survival of mankind could be threatened by the global consequences of a nuclear war,

I think that this is very important. I think that although it will not, of course, have an immediate impact, it will gradually influence the entire political situation on earth.... Science itself provides a splendid political argument.... Hitherto our discussions have been based more or less on emotional factors. But now they are based on precise figures.⁶

Aside from the fact that the "figures"--as both the TTAPS group and Velikhov himself have indicated--are far from being "precise" and are fraught with great uncertainties, this statement appeared to imply that the Soviet Union would also be slow in facing up to the implications of the "Nuclear Winter" hypothesis. Indeed, it is noteworthy that Soviet scientists have not publicly endorsed Sagan's recommendations on the reduction of the yields of existing warheads and of national nuclear stockpiles to or below an aggregate yield of 100 MT.⁷

Moiseyev was right if he had meant to imply that the Soviet Union would be slow to react. In fact the Soviet reaction has been in the opposite direction from the one he claimed to expect. For example, in a televised address to the members of the USSR Academy of Sciences on March 14, 1984, the president of the Academy, A.P. Aleksandrov, after warning that a nuclear war may make the world "uninhabitable" and result in the death of mankind, gave the following marching orders to Soviet scientists:

Comrades, two sides of this matter are closely related to our work. One is raising the economic potential of our country, our fastest possible technical development; the other--and it too is

extremely important--is promoting the development of our defense technology, the creation of defense technology that would make an attack on our country unacceptable.⁸

This sounded suspiciously as saying that "more" rather than "less" is better.

Similarly, Velikhov published an article in April 1984, in which he wrote:

Conscious of their patriotic duty, Soviet scientists have always and are today exerting every effort to ensure the independent development of the decisive areas of our science and technology in order to strengthen the defense capability of our country and its allies as a counterbalance to the aspirations of aggressive circles in the West. I would put it this way: anything that has to be done to foil imperialist attempts at achieving military superiority over the socialist states will be done immediately and without fail.⁹

He wrote this even while citing the conclusions of the November 1, 1983, television conference of US and Soviet scientists to the effect that the atmospheric, ecological and biological consequences of a nuclear war would be "nothing short of catastrophic."

At about the same time, the Soviets appeared to have found it necessary to explain why they persisted in strengthening their civil defense despite the Soviet scientists' dire predictions of the consequences of a nuclear war. In his December 8, 1983, statement at the "Joint American-Soviet Scientific Forum on Nuclear War," Velikhov had asserted that "protection against nuclear weapons is unreal (i.e. unrealistic)."¹⁰ On April 24, 1984, however, Radio Moscow broadcast in English a reply by a well known "military affairs specialist," Dr. Lev Semeyko, to the following question:

In recent years leading scientists around the world have come to believe that a nuclear conflict would mean the end of civilization, yet a number of countries, including the Soviet Union, continue to strengthen their civil defense, building shelters and training their populations to handle protective gear. Is there any logic in this, and is this a sign that vigorous preparations are under way for nuclear warfare?¹¹

Semeyko's reply was that there can be no "full protection" against nuclear war, "yet the Soviet Union is working on strengthening its civil defense" for several reasons. It does so to show "concern" for the lives of Soviet citizens because the latter expect their government to do so, and also because the protection of the Soviet Union against possible nuclear aggression "requires not only armed forces that would stand up to such aggression, but an effective system of civil defense as well." While asserting that "the West deliberately understates possible Soviet losses" when it claims that in a nuclear war the Soviet Union may lose only 10 percent of its population, Semeyko was careful not to say that the Soviet Union may be destroyed. All he was willing to grant was that "such a war would be a disaster."

The dichotomy between Soviet propaganda on the consequences of a nuclear war for foreign and domestic consumption is reflected in the current directives for the training of Soviet public civil defense instructors and propagandists published in the July 1984 issue of the journal Military Knowledge. According to this directive:

A nuclear war, if it is unleashed by the imperialists, will cause uncountable losses to the peoples of the world. This is known by our people. Soviet scientists and public spokesmen carry out active work with the aim of bringing this truth to the cognizance of the world's general public

and, thereby, narrow the field of action of the militaristic forces. However, knowledge of the destructive effects of modern weapons must not morally disarm our people before the aggressor. While telling about the destructive characteristics of modern weapons, the propagandists should be guided by V.I. Lenin's teaching to the effect that our propaganda, aimed at raising discipline and at strengthening military preparation, must not overstep those limits where we, ourselves contribute to panic.¹²

The same directive also pointed out that the mission of civil defense propaganda is to instill in the Soviet people "firm confidence in the indestructible might of the Soviet Armed Forces and in the effectiveness of civil defense measures," as well as prepare the population "morally and psychologically for the possible trials of a war."¹³

To date, there is no indication that the implications of a possible "Nuclear Winter" effect have in any way influenced Soviet strategic doctrine or programs for the further build-up of Soviet strategic nuclear forces. For example, the Chief of the General Staff and First Deputy USSR Minister of Defense, Marshal of the Soviet Union, N.V. Ogarkov, wrote in May 1984 that while both the United States and the Soviet Union already possess sufficient strategic weapons "to destroy all the important targets on the enemy's territory many times over," the "buildup is continuing," even though it is "senseless."¹⁴ Furthermore, according to Ogarkov,

*The calculation of the strategists across the ocean, based on the possibility of waging a so-called "limited" nuclear war, now has no foundation whatever. It is utopian: Any so-called limited use of nuclear forces will inevitably lead to the immediate use of the whole of the sides' nuclear arsenal. This is the terrible logic of war.*¹⁵

There is obviously an inconsistency between the officially sponsored Soviet campaign by scientists to portray the consequences of a nuclear war in the most pessimistic terms, and the calls emanating from the top Soviet political and military leadership for the further build-up of Soviet strategic and civil defense capabilities. This dichotomy, however, is more apparent than real. The Soviet scientific establishment is a part of the Soviet state and communist party organization. It has the possibility of directly influencing the leadership's views and policies, if Soviet scientists were true believers in the "Nuclear Winter" phenomenon and could validate it with their own research. To date, however, there is no sign that this is the case. This is not to say that some Soviet scientists have not become personally concerned about the possible "catastrophic" global consequences of a nuclear war. But so far this concern has not been supported, at least in public, by the comprehensive independent research necessary to validate it.

All indications are in fact that the main Soviet objective in supporting the "Nuclear Winter" hypothesis has been to exploit and manipulate this issue for potential political and propaganda gains. Soviet statements indicate that this objective includes: broadening Soviet contacts with and increasing influence among influential groups of Western scientists, manipulating Western public opinion and enhancing opposition to US defense programs, and promoting Soviet "peace policy" and arms control proposals. In his speech in May 1983 Politburo candidate member B. Ponomarev had made clear that the primary mission of Soviet scientists concerning the questions of the possible consequences of a nuclear war is a political one.¹⁶ The "Nuclear Winter" issue was perceived as providing the Soviet Union with a political and propaganda opportunity in which the "authority" of Soviet scientists and physicians could be used to influence Western public perceptions and attitudes and hopefully also policies. For this purpose it was sufficient for Soviet scientists to publicly adopt Western "worst-case" scenarios and war outcome predictions and merely give the impression of providing them

with "independent" Soviet confirmations. The fact that the paucity of Soviet contributions to the "Nuclear Winter" study effort has recently led Western scientists to become increasingly "disappointed" in the role played by Soviet science is of little concern to the Soviet Union. The Soviet campaign on the "catastrophic" consequences of a nuclear war has already gained considerable political and propaganda mileage from the hearing given it in the West, and the Soviets have every reason to expect to be able to continue this activity. Indeed, a similar Soviet "scientific" campaign is now underway, led by the same Ye.P. Velikhov, against President Reagan's Strategic Defense Initiative.

FOOTNOTES (Section 6)

1. P.R. Ehrlich, C. Sagan, D. Kennedy, W.O. Roberts, The Cold and The Dark; the World After Nuclear War, (New York, N.Y.; W.W. Norton & Company, 1984), p. 146.
2. "Soviets Offer Little Help," Science, July 1984, p. 31.
3. For example, see Army General A.T. Altunin, Formirovaniya Grazhdanskoy Oborony v Bor'be so Stikhiynymi Bedstviyami (Civil Defense Formations in the Struggle with Natural Disasters) 2nd edition, (Moscow: Stroyizdat, 1978), p. 23; The New York Times October 20, 1976; V. Yemel'yanchuk, "Saving the Tayga," Sovetskiy Patriot (Soviet Patriot), August 18, 1976; "Six Anxious Days," Komsomol'skaya Pravda (Kamsomal Pravda), May 6, 1976.
4. "Soviets Offer Little Help," op. cit.
5. Ibid.
6. Radio Moscow, May 16, 1984, cited in FBIS Daily Report: Soviet Union, June 6, 1984, pp. AA7-AA8 (emphasis added).
7. Carl Sagan, "Nuclear War and Climatic Catastrophe: Some Policy Implications," Foreign Affairs, Winter 1983-1984, pp. 275-292.
8. Academician A.P. Aleksandrov, speech at the general meeting of the USSR Academy of Sciences, March 14, 1984, Moscow Television, March 15, 1984, cited in FBIS Daily Report: Soviet Union, April 3, 1984, p. U1.
9. Ye. P. Velikhov, "Scientists Against the Threat of Nuclear War," Slovo Lektora (The Lecturer's Word), No. 4, April 1984, p. 17.
10. Statement by Ye. P. Velikhov at Senators E. Kennedy-M. Hatfield hearings on the "Joint American-Soviet Scientific Forum on Nuclear War," December 8, 1983.
11. Radio Moscow in English, April 24, 1984, cited in FBIS Daily Report: Soviet Union, April 25, 1984, p. V1.
12. "Concerning the Program for Preparing the Leadership Element: Civil Defense Propaganda," Voyennyye Znaniya (Military Knowledge), No. 7, July 1984, p. 23. (emphasis added)
13. Ibid., p. 25.

14. Marshal of the Soviet Union N.V. Ogarkov, "The Defense of Socialism: Experience of History and the Present Day," Krasnaya Zvezda (Red Star) May 9, 1984.
15. Ibid.
16. B. Ponomarev, "The Role of Scientists in Strengthening International Security," Supplement to Moscow News, No. 23, June 12-17, 1983, pp. 4-5.

SECTION 7

CONCLUSIONS

Despite the widespread impression in the West that Soviet scientists have independently confirmed the probability of the occurrence of a "Nuclear Winter" as a consequence of a nuclear war, in fact this is not the case. For public consumption Soviet scientists have neither published independent nuclear weapon laydown scenarios nor provided in their discussions of the "Nuclear Winter" hypothesis independent values for the essential parameters characterizing soot which are critical for it. Indeed, as Western scientists are increasingly becoming aware, despite the great deal of publicity given to the papers and statements of Soviet scientific spokesmen in the West, they have contributed very little, if at all, to the international "Nuclear Winter" study effort.

What Soviet scientific spokesmen appear to have done is to uncritically adopt the scenarios and values of essential parameters of dust and soot from nuclear detonations from Western studies and use them in crude and flawed models of post-exchange global atmospheric circulation. Not only that, but Soviet scientists have failed so far to respond to requests by Dr. Sagan and other U.S. scientists for Soviet data on the effects of pre-1963 Soviet nuclear tests in the atmosphere and of large fires, as well as for information on the range of nuclear war scenarios the Soviets consider likely. Thus, given the similarity of Soviet inputs to their studies with those used by Western scientists, the similarity of Soviet findings with the worst-case "Nuclear Winter" projections of the Crutzen-Birks (Ambio, 1982) and TTAPS (Science, December 1983) studies was inevitable. In no way can this be taken to represent independent Soviet confirmation or verification of the TTAPS "Nuclear Winter" hypothesis.

This is not to say that over the years there have been no Soviet studies examining various effects and phenomena of nuclear detonations, such as dust, fires, soot, etc. The findings of these studies and their possible relevance to Soviet assessments of the "Nuclear Winter" hypothesis remain to be examined and analyzed. To date, however, the Soviets have made little use of such findings in their public discussions and models of "Nuclear Winter."

The experience of the past two years with Soviet involvement in "Nuclear Winter" studies strongly indicates that the Soviets have been pursuing political rather than scientific objectives. These objectives, as they had been enunciated by a Politburo member, were to reinforce the "anti-nuclear" movement in the West, to enhance opposition among the Western public--and especially the scientific community--to US programs to modernize its strategic forces, and to lend support to Soviet arms control proposals. For this purpose, it was sufficient for Soviet scientific spokesmen to uncritically adopt in toto Western "worst-case" war scenarios and predictions of the consequences of nuclear war, and to merely give the impression of their "independent" confirmation. From the Soviet viewpoint, therefore, there is no utility in becoming involved in the scientific debate in the West over the validity of the TTAPS study's assumptions and projections or to develop--at least in public--scenarios or data which may be at variance with them.

The Soviets obviously believe that this use of Soviet scientists has produced significant gains in terms of widened contacts and cooperation with Western scientists, influence on Western public opinion, and support for Soviet policies. Indeed, the Soviet Union is now attempting to repeat this strategy in a similar "scientific" campaign conducted jointly with some American and other Western scientists against President Reagan's Strategic Defense Initiative.

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